ATTI DI CONVEGNO

Herein are summaries of presentations of the 14th Equitation Science Conference held in Rome in 2018. Along with synopses of plenary talks and practical demonstrations are abstracts describing recent research within the broad emerging field of Equitation Science.

The Mission of ISES is to promote and encourage the application of objective research and advanced practice which will ultimately improve the welfare of horses in their associations with humans.
La Giornata di Studio è stata la prima occasione in ambito accademico per riflettere sulla ricezione di questo romanzo, sul suo ruolo nella formazione dell'immagine dell'Italia all'estero, nonché sulle diverse dinamiche culturali che entrano in gioco a seconda dei contesti in cui esso viene a trovarsi.

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for Equitation Science
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PROCEEDINGS OF THE 14TH INTERNATIONAL CONFERENCE

ATTI DI CONVEGNO

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Equitation Science 150 years after Caprilli: theory and practice, the full circle

September 21–24, 2018, Hosted by Regiment "Lanceri di Montebello", Roma, Italy

Proceedings edited by
Sue McDonnell, Barbara Padalino, Paolo Baragli

PISA UNIVERSITY PRESS

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ISES 2018 - ROME
14th International Equitation Science Conference

September 21-24, 2018

Equine welfare:
good training, good feeding, good housing,
good mental state, good health, good behaviour.

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International Society for Equitation Science
Presents

14th International Equitation Science Conference
September 21-24, 2018
Rome, Italy

Editors: Sue McDonnell, Barbara Padalino, Paolo Baragli

"Sometimes very good school horses appeared disgusted after several jumps and he wondered, pondering with careful observation, if in addition to strain couldn't there be some other cause that made even the best horses refuse or run-out. If there was a reason, beyond fatigue, it needed to be removed and therefore horse-riding had to change."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 29)

Contents

"And let us bear in our minds that when a horse opposes resistance, is restless, runs away, briskly stops or defends itself, this is almost always to avoid a pain, or for fear of pain, that the rider's action causes it. This actual pain or the fear of pain once experienced very often means that the horse reacts, or though submitting, it won't use its forces in a natural way, thus making an unnecessary and harmful effort."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 72)

President's welcome to ISES 2018 Rome

Welcome to the 14th Equitation Science Conference! Welcome to Rome! Some of you are already very familiar with the **International Society for Equitation Science (ISES)** whereas others are new to the society and are attending your very first ISES conference. I would like to welcome both old friends and colleagues and those of you that are new to the society – I am sure we all have some very enjoyable days ahead. If this is your first scientific conference, don't worry – ISES is a very friendly society and if you get lost in a presentation, just ask your neighbour! The conference proceedings also provides both a glossary and a quick guide to statistics for non-scientists that briefly explains what "p-values" are all about. Indeed, one of the main drivers of ISES's work is to provide objective, evidence-based knowledge to the end user - the equestrian practitioner - at all levels. In order to facilitate this, each scientific abstract is accompanied by a Lay Persons Message to assist with the communication of the main results.

> "*The Mission of ISES is to promote and encourage the application of objective research and advanced practice which will ultimately improve the welfare of horses in their associations with humans*"

I have been looking forward to this conference since the closing of the 13th conference in Wagga Wagga, Australia, in November last year. While last years' conference focussed on collaboration, communication and human behaviour change in relation to equestrian practice, this year's conference theme will take a detailed look at the cornerstones for good equine welfare: that is, good training, good feeding, good housing, good mental states, good health and good (appropriate) behaviour. While much focus in equitation science is on training, we must also remember 'the other 23 hours', i.e. the large proportion of the day where the horse is not being trained. It is well-known that optimal training depends on good horse welfare, appropriate arousal levels and positive affective states. Stress resulting from e.g. lack of fulfilment of biological needs, such as company of other horses, access to roughage and free locomotion, does not only lead to impaired welfare but also suboptimal learning performance. Optimal training is therefore dependent on good horse welfare. And that is what this conference is all about.

On behalf of the ISES council, I would like to extend my whole hearted thanks to the Local Conference Organising Committee for all your hard work for this conference, which saw the largest number of submitted abstracts to date.

Enjoy the conference, take home as many messages as possible, embed them into practice and spread them widely in order to help to ensure and safeguard horse welfare, regardless of size, breed or discipline. I am very much looking forward to the next few days. I hope you are too.

ISES Honorary President

Janne Winther Christensen

Welcome from the Local Conference Organising Committee

Welcome to Rome and the 14th annual International Equitation Science conference. The link between the Eternal City and the horse to which the most famous artists have given their tribute over the centuries is rooted in history. Statues of horses surmount the highest hill of Rome, the Quirinale, home of the political power. The Dioscuri and their horses, the monumental equestrian sculpture of Marcus Aurelius overlooking the Campidoglio and a four horses chariot on the Vittoriano represents a free Italy.

The entire conference is hosted by the 8th Lanceri Di Montebello armed forces. This year is the 150th anniversary of Federigo Caprilli's birth who lived and worked at the Lancieri's headquarters, precisely in the same places where the conference is taking place.

Caprilli was a precursor of Equitation Science. He studied the natural horses' way of going and invented the "forward seat". A riding system that allows the horses to express all their potential and improves their welfare. Most of his quotes are in alignment with our 10 Principles. For example about the correct use of operant conditioning, he said: "I admit that the whip wrongly used causes more evil than good, chances of disgrace and therefore it arises fear…but the instructor must absolutely learn to use it in order to manage it well and with a proper standard; then these inconveniences will be removed." Carlo Giubbilei "Federico Caprilli, Vita e scritti", p. 105.

Rome is also the city of great equestrian events: the historic CSIO of Piazza di Siena, the Longines Global Champions Tour and the Roman Carnival. It is therefore an honor to be able to organize in Rome the XIV International Conference of the International Society for Equitation Science. The year in which the birth of modern equitation is celebrated.

We wish to thank all the institutions, associations and professionals who have supported us and who have collaborated for the best outcome of this initiative.

Chairs of the Local Conference Organising Committee
Eleonora di Giuseppe
Angelo Telatinn

> *"Finally, after much observing and trying, and especially riding horses that presented difficulties, who felt and suffered a lot the hand's actions, to which they reacted disarranging and running away; little by little one succeeded in trying to put an end to any hand's action on the horse that is not strictly necessary to direct or to stop."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 73)

Welcome from the Scientific Committee

Welcome to Rome and to ISES 2018. We sincerely hope you all will enjoy your time in Rome. We are particularly delighted that you are visiting on the occasion of the 150th anniversary of Caprilli who was a pioneer in equitation science and horse welfare.

ISES's aim is to enhance horse welfare. However, are we able to assess welfare? What is a happy horse? We should be able to ensure a good life for horses, but do we yet know enough about what that means from the horse's point of view?

We are meeting in Rome to discuss and try to find the way to answer these questions. Many giants of horse behaviour and welfare are gathering here to share the findings of their most recent studies and to mentor the young scientists who are taking their first steps in this challenging field of study. In addition, riders and vets, owners and caretakers are all contributing to this conference. We are all motivated by the same passion for horses and the will to give a good life to all horses.

Therefore, we are delighted to welcome all horse lovers to Rome and we look forward to discussing all topics related to good training, good housing, good feeding, good behaviour and good mental state.

Organising ISES 2018 has kept us busy for the last year. We have enjoyed working as an international team. Thanks to hundreds of authors worldwide submitting nearly 180 abstracts, we have been able to select a wonderful collection of presentations. If each attendee goes back home having learned something new, something inspiring, something that can enhance the life of one or of a thousand horses, our work will be repaid and we will reach our aim of enhancing horse welfare worldwide.

For the horses,

The Scientific Committee
Barbara Padalino
Paolo Baragli
Emanuela Valle
Michela Minero
Sue McDonnell

"An excellent Caprilli's skill [...] was his tendency to continually evolve, always accepting anybody's experimental proposals, happy when they caused the modification of his ideas to improve the art to which he dedicated his whole life."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 27)

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> *"Help with your legs, weaken your hands' pressure, follow with your chest the horse's shifts in balance."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 119)

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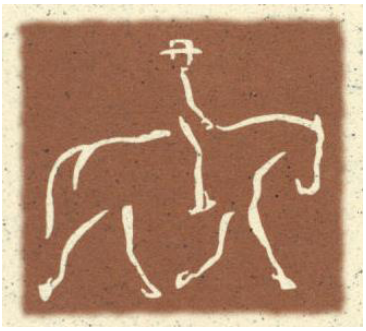
Petra Buckley (Charles Sturt University, Australia)
Robin Foster (Horse Behaviourist, USA)
Sarah Rosanowski (City University of Hong Kong)
Warwick Bayley (Washington State University, USA)

"And, during the exercise, the instructor should be very attentive in fighting stiffness [of rider ndt], in whatever aspect and in any part of the body it shows, for it always ends up propagating in the hands, thus producing a painful action on the horse's mouth which is transmitted to the kidneys."

Carlo Giubbilei "Federico Caprilli, Life and Writings", p. 81

Sponsorship



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The new ISES training principles

A. McLean, P.D. McGreevy and ISES Council

Human and horse welfare depend upon training methods and management that demonstrate:

1. **Regard for human and horse safety**
   - Acknowledge that horses' size, power and potential flightiness present a significant risk
   - Avoid provoking aggressive/defensive behaviours (kicking /biting)
   - Ensure recognition of the horse's dangerous zones (e.g hindquarters)
   - Safe use of tools, equipment and environment
   - Recognise the dangers of being ineffective, inconsistent or confusing
   - Ensure horses and humans are appropriately matched
   - Avoid using methods or equipment that cause pain, distress or injury to the horse

"Disregarding safety greatly increases the danger of human-horse interactions"

2. **Regard for the nature of horses**
   - Ensure welfare needs: lengthy daily foraging, equine company, freedom to move
   - Avoid aversive management practices (e.g. whisker-trimming, ear-twitching)
   - Avoid assuming a role for dominance in human/horse interactions
   - Recognise signs of pain
   - Respect the social nature of horses (e.g. importance of touch, effects of separation)
   - Avoid movements horses may perceive as threatening (e.g jerky, rushing movements)

"Isolation, restricted locomotion and limited foraging compromise welfare"

3. **Regard for horses' mental and sensory abilities**
   - Avoid overestimating the horse's mental abilities (e.g. "he knows what he did wrong")
   - Avoid underestimating the horse's mental abilities (e.g. "It's only a horse...")
   - Acknowledge that horses see and hear differently from humans
   - Avoid long training sessions (keep repetitions to a minimum to avoid overloading)
   - Avoid assuming that the horse thinks as humans do
   - Avoid implying mental states when describing and interpreting horse behaviour

"Over- or underestimating the horse's mental capabilities can have significant welfare consequences"

4. **Regard for current emotional states**
   - Ensure trained responses and reinforcements are consistent
   - Avoid the use of pain/constant discomfort in training
   - Avoid triggering flight/fight/freeze reactions
   - Maintain minimum arousal for the task during training
   - Help the horse to relax with stroking and voice
   - Encourage the horse to adopt relaxed postures as part of training (e.g. head lowering, free rein)
   - Avoid high arousal when using tactile or food motivators
   - Don't underestimate horse's capacity to suffer
   - Encourage positive emotional states in training

"High arousal and lack of reinforcement may lead to stress and negative affective states"

5. **Correct use of habituation/desensitization/calming methods**
   - Gradually approach objects that the horse is afraid of or, if possible, gradually bring suchaversive objects closer to the horse (systematic desensitization)
   - Gain control of the horse's limb movements (e.g. step the horse back) while aversive objects are maintained at a safe distance and gradually brought closer (over-shadowing)
   - Associate aversive stimuli with pleasant outcomes by giving food treats when the horse perceives the scary object (counter-conditioning)

- Ignore undesirable behaviours and reinforce desirable alternative responses (differential reinforcement)
- Avoid flooding techniques (forcing the horse to endure aversive stimuli)

"Desensitization techniques that involve flooding may lead to stress and produce phobias"

6. **Correct use of Operant Conditioning**
   - Understand how operant conditioning works: i.e. performance of behaviours become more or less likely as a result of their consequences.
   - Tactile pressures (e.g. from the bit, leg, spur or whip) must be removed at the onset of the correct response
   - Minimise delays in reinforcement because they are ineffective and unethical
   - Use combined reinforcement (amplify pressure-release rewards with tactile or food rewards where appropriate)
   - Avoid active punishment

"The incorrect use of operant conditioning can lead to serious behaviour problems that manifest as aggression, escape, apathy and compromise welfare"

7. **Correct use of Classical Conditioning:**
   - Train the uptake of light signals by placing them BEFORE a pressure-release sequence
   - Precede all desirable responses with light signals
   - Avoid unwanted stimuli overshadowing desired responses (e.g. the horse may associate an undesirable response with an unintended signal from the environment)

"The absence of benign (light) signals can lead to stress and compromised welfare"

8. **Correct use of Shaping**
   - Break down training tasks into the smallest achievable steps and progressively reinforce each step toward the desired behaviour
   - Plan training to make the correct response as obvious and easy as possible
   - Maintain a consistent environment to train a new task and give the horse the time to learn safely and calmly
   - Only change one contextual aspect at a time (e.g trainer, place, signal)

"Poor shaping leads to confusion"

9. **Correct use of Signals/Cues**
   - Ensure signals are easy for the horse to discriminate from one another
   - Ensure each signals has only one meaning
   - Ensure signals for different responses are never applied concurrently
   - Ensure locomotory signals are applied in timing with limb biomechanics

"Unclear, ambiguous or simultaneous signals lead to confusion

10. **Regard for Self-carriage**
    - Aim for self-carriage in all methods and at all levels of training
    - Train the horse to maintain:
      - gait
      - tempo
      - stride length
      - direction
      - head and neck carriage
      - body posture
    - Avoid forcing any posture
    - Avoid nagging with legs, spurs or reins i.e. avoid trying to maintain responses with relentless signaling.

"Lack of self-carriage can promote hyper-reactive responses and compromise welfare"

Scientific programme

Only the presenting author and her/his affiliation are mentioned.
Please refer to the abstracts for further information.

Scientific sessions (Friday 21nd, Saturnday 22nd and Sunday 23nd) hosted at Regiment "Lanceri di Montebello", the Official's Club, via Flaminia 826, 00191 Roma.

Day 1 - Friday September 21nd 2018

		Acronym* and related page of abstract
2.00 PM	Conference registration	
3.30–5.00 PM	**Workshop 1** - BUILDING BRIDGES BETWEEN THEORY AND PRACTICE: HOW THE EQUINE ASSESSMENT AND RESEARCH QUESTIONNAIRE (E-BARQ) BRINGS RESEARCHERS AND PRACTITIONERS TOGETHER (**K. Fenner**, University of Sydney, Australia)	**W1** 21
3.30–5.00 PM	**Workshop 2** - EMERGING TECHNOLOGIES AND METHODS FOR NON-INVASIVE ACQUISITION AND ANALYSIS OF PHYSIOLOGICAL SIGNALS: HOW MUCH CAN HRV REVEAL ABOUT THE HORSES' INNER STATE? (**P. Baragli**, University of Pisa, Italy)	**W2** 22
5.30 PM	Official Welcome and welcome drink	
5.45 PM	Caprilli's Heritage: INNOVATION AND HORSE WELFARE BEHIND THE HISTORICAL PERSPECTIVE (**D. Bergero**, University of Turin, Italy)	**PL1** 24
6.00 PM	"Clever Hans" lecture – JUST HOW GOOD ARE HORSES AT READING HUMAN-GIVEN CUES? (**L. Proops**, University of Portsmouth, UK)	**PL2** 25
6.45 PM	TEN ISES PRINCIPLES OF LEARNING THEORY IN EQUITATION (**A. McLean**, Equitation Science International, Australia)	**PL3** 11

"The instructor will teach that the hands must be kept naturally and as close as possible and firmly sideways to the withers, and that in all the movements and reactions the rider receives, they must always be kept down and ready to slip in the direction of the mouth to allow the horse to take the neck position that best suits it, without getting hit on the bars, but always having the same slight support. This is the most important thing and at the same time the most difficult to be done always and well, and on it the instructor must not get tired of insisting from the beginning."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 79)

Day 2 – Saturday September 22nd 2018

		Acronym* and related page of abstract
8.45-9.00 AM	Opening Ceremony • Sue McDonnell and Barbara Padalino • Eleonora Di Giuseppe and Angelo Telatin	
9.00-9.30 AM	Official opening from authorities • Prof J.W. Christensen (President of ISES) • Other authorities	
	Theme: **GOOD TRAINING** / Chair: Angelo Telatin	
9.30-10.15 AM	STRESS AND LEARNING IN HORSES (**J.W. Christensen**, Aarhus University, Denmark)	**PL4** 26
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10.30-10.45 AM	APPROACH TO THE GATE: EXAMINING CONFLICT BEHAVIOUR IN THROUGHBRED RACEHORSES (**G. Pearson**, Royal [Dick] School of Veterinary Studies, UK)	**O2** 29
10.45-11.00 AM	HORSES' LEARNING PERFORMANCE WHEN USING DIFFERENT TRAINING SCHEDULES (DAILY VS. EVERY THREE DAYS TRAINING SESSIONS) TO TRAIN NOVEL TASKS VIA NEGATIVE REINFORCEMENT (**U. Konig v. Borstel**, Justus-Liebig University of Giessen, Germany)	**O3** 30
11.00-11.45 AM	Coffee break and daily themes relate poster view	
	Theme: **GOOD TRAINING** / Chair: Hayley Randle	
11.45-12.00 AM	THE EFFECT OF EQUINE VISUAL ADAPTATION ON OBSTACLE NEGOTIATION UNDER DIFFERENT LIGHT LEVELS (**C. Hall**, Nottingham Trent University, UK)	**O4** 31
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12.30-12.45 AM	TO RUG OR NOT TO RUG: POTENTIAL IMPACTS ON EQUINE WELFARE (**K. Hodgess**, Duchy College, UK)	**O24** 57
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	Theme: **HORSE WELFARE ASSESSMENT** / Chair: Roly Owers	
2.30-3.15 PM	HORSE WELFARE ASSESSMENT WITH ANIMAL BASED INDICATORS (**M. Minero, E. Valle, D. Loni and B. Padalino**)	**PL9** 60
3.15-3.30 PM	PRELIMINARY STUDY TO DEVELOP A STANDARDISED WELFARE ASSESSMENT PROTOCOL SUITABLE FOR ASSESSING THE WELFARE OF HORSES RESIDING IN TWO UK CHARITIES (**L. Preshaw**, Royal Veterinary College, UK)	**O27** 62
3.30-3.45 PM	MONITORING HERD HEALTH IN DONKEYS USING WELFARE ASSEMENT AND CLINICAL RECORDS (**A.K. Thiemann**, The Donkey Sanctuary, UK)	**O28** 63
3.45-4.00 PM	EXPLORING PUBLIC PERCEPTIONS OF EQUINE WELFARE SCENARIOS USING A POSITIVE APPROACH (**E.A. Lofgren**, Purdue University, USA)	**O29** 64
4.00-4.15 PM	THE WELPA PROJECT: IMPROVING EQUINE WELFARE IN RIDING SCHOOLS AND LIVERY YARDS THROUGH HUMAN BEHAVIOURAL CHANGE (HBC) (**M. van Dierendonck**, Ghent University, Belgium)	**O30** 65
4.15-5.00 PM	Coffee break and daily themes relate poster view	
	Theme: **HORSES, RIDERS AND OWNERS** / Chair: Camie Heleski	
5.00-5.15 PM	DO EQUESTRIANS HAVE INSIGHT INTO THEIR EQUINE-RELATED KNOWLEDGE (OR LACK OF KNOWLEDGE)?(**D.M. Marlin**, Cambridge, UK)	**O31** 66
5.15-5.30 PM	CONSPICUITY EQUIPMENT AND ITS CONTRIBUTION TO THE WELFARE OF HORSE AND RIDER COMBINATIONS USING THE ROAD SYSTEM IN THE UNITED KINGDOM (**R.M. Scofield**, Oxford Brookes University, UK)	**O32** 67
5.30-5.45 PM	A PLACE FOR WELFARE AND WELLBEING – YOUNG RIDERS' THOUGHTS ABOUT THE FUTURE RIDING SCHOOL IN SWEDEN (**G. Thorell**, Ridskolan Strömsholm, SWE)	**O33** 68
5.45-6.00 PM	EUTHANASIA IS RESPONSIBLE OWNERSHIP (**R. A. Owers**, World Horse Welfare, UK)	**PL10** 69
6.00-6.30 PM	**ISES Annual General Meeting (AGM)**	

* PL = Plenary; O = Oral

"...and I wonder how could the horse be able to understand what it is requested if with the same identical action, we ask it two opposite things?"

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 254)

Practical Day programme

Practical Day hosted at the barn Ippodromo Militare, Viale di Tor di Quinto, 114, 00191, Roma.

Day 4 – Monday September 24nd 2018

			Acronym* and related page of abstract
8.45-9.00 AM	**Housekeeping, communications**	Michela Minero	
9.00-9.15 AM	Opening of the practical day	Paolo Baragli	
9.15-9.45 AM	How to gain and maintain compliance with mildly aversive healthcare, grooming and management procedures	Sue McDonnell	**PD1** 71
9.50-10.20 AM	How to assess Body Condition Score	Pat Harris & Emanuela Valle	**PD2** 73
10.25-10.55 AM	Coffee break		
10.55-11.25 AM	How to assess the fitness for transport of equidae	Barbara Padalino	**PD3** 75
11.30-12.00 AM	How to manage a barn fire	Rebecca Gimenez	**PD4** 76
12.00 AM-1.00 PM	Lunch		
1.00-1.45 PM	How to communicate with your horse freely	Marco Pagliai	**PD5** 77
1.50-2.35 PM	How to communicate with your horse under saddle	Angelo Telatin	**PD6** 78
2.40-3.25 PM	How to become a champion	High level performance riders	**PD7** 79
3.30-4.00 PM	Coffee break		
4.00-5.00 PM	Wrapping up	All speakers of the practical day	
5.00-6.00 PM	Closing Ceremony: Prices and awards, acknowledges, presentation of ISES 2019	Sue McDonnell & Barbara Padalino - Angelo Telatin & Eleonora Di Giuseppe	

* PD = Practical Day

"...it was always suggested the flexibility of the wrist, to support at any gait the movement of the horse's head, still keeping the same very light support in its mouth."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 204)

Biographies of plenary speakers and practical day presenters

Prof. Sue McDonnell holds Bachelors and Master's degrees in human and animal psychology, a PhD in reproductive physiology and behaviour from the University of Delaware, and is board certified as an Applied Animal Behaviourist by the Animal Behavior Society. Dr. McDonnell's career has been based at the University of Pennsylvania School of Veterinary Medicine's New Bolton Center, where she is currently an Adjunct Professor and Clinical Associate of their Widener Hospital, and Founding Head of the Havemeyer Equine Behavior Program. Dr McDonnell's work at Penn Vet includes clinical, research, and teaching activities in reproduction and behaviour, with particular expertise in stallion reproductive physiology and behavior. Dr McDonnell also consults with veterinarians and farm managers internationally on stallion breeding behaviour and management. She also assists insurance companies, courts and legal teams with matters involving questions of stallion behaviour, general horse behaviour, human-horse interaction, as well as equine welfare. In addition to scientific research publications, clinical case reports and review chapters, Dr. McDonnell has authored two introductory level books on horse behaviour, as well as a book and DVD entitled The Equid Ethogram: A practical field guide to horse behaviour, cataloguing behaviour of horses under both domestic and natural conditions. She is also the co-editor with Dr Daniel Mills of The Domestic Horse, an international review of horse behaviour research. She writes a monthly column for The Horse magazine, and contributes regularly to other equine industry magazines in North America and Europe. In 2004, the American College of Theriogenologists awarded Dr McDonnell Honorary Membership for contributions to clinical reproduction, and in 2011 the American Association of Equine Practitioners honoured her with the George Stubbs Award for contributions by non-veterinarians to veterinary medicine. She also serves on the BLM's National Wild Horse and Burro Program's Advisory Board.

Prof Michela Minero qualified as a DVM, gained a PhD in Animal Science, and she currently works as an Associate Professor at the Department of Veterinary Medicine (University of Milan). She is a member of the European College of Animal Welfare and Behavioural Medicine. Horses and donkeys have always represented a genuine passion for her and she found hard to choose between a career as a clinician and the curiosity about equine behaviour. She is still interested in researching topics where the two areas may be combined. She has mainly been working in the area of animal behaviour and welfare: her areas of particular professional interest include assessing animal welfare in relation to their management characteristics, developing innovative equine welfare indicators and human-horse interactions.

Dr Barbara Padalino graduated in Veterinary Medicine at the University of Bari (Italy) in 2002, and in 2014 moved to Australia to conduct a PhD in equine road transportation at the University of Sydney. She currently works as a researcher at the Department of Veterinary Medicine, University of Bari, Italy and as Assistant Professor in Animal Behaviour and welfare at the College of Veterinary Medicine and Life Sciences, City University of Hong Kong Horses have characterised all her life, and she has been a rider, a driver, a Standardbred horse breeder, an equine veterinarian and an equine scientist! She is passionate about research on transport related stress. However, her research spans a number of topics from equine behaviour and welfare to internal and sports medicine. She is a member of the Animal Transport Association (ATA), the International Society of Equitation Science (ISES) and the European Association of Animal Production (EAAP). She often publishes/presents in peer reviewed international journals and conferences on topics related with equine health and welfare.

Dr Emanuela Valle DVM, PhD, EBVS® European Specialist in Veterinary and Comparative Nutrition, graduated from the Torino University where she then went on to complete a residency in animal nutrition subspecialties equine and a PhD in animal production. Currently she has a permanent position as Assistant Professor at the Department of Veterinary Science. She spent a six months period as a visiting researcher at the Middleburg Agricultural Research and Extension Center (Virginia Tech). She is in charge of the Clinical nutrition counselling service at the teaching veterinary hospital, with particular reference to the nutrition of equine patients. Her teaching activities are related to animal management and equine welfare courses and equine clinical nutrition for vet students. She is author of over

50 peer-reviewed scientific publications, conference papers, abstracts and lectures; she is also active in the horse community since she contributes to leisure equine magazines and with course for the Italian equestrian federation. When she is not busy with work, she enjoy riding and spending time with her equines and dogs and her family.

Dr Donatella Ioni qualified as DVM, working from 2008 for the Animal Welfare Office of the Ministry of Health in Italy. Her mainly professional involvement is the enforcement of the legislations concerning the equine welfare, she was part of a special Task Force created By the Ministry to support the local authorities in cases of companion animals and equine abuse. Before 2008 she was working like a veterinarian practitioner in a private practice on equine clinic. Post Graduated Specialization Course on Applied Ethology and Animal Welfare.

Prof Janne Winther Christensen is an Associate Professor in the Behaviour and Stress Biology group at Aarhus University, Denmark. She has studied behaviour of Przewalski horses in the Askania Nova Reserve in Ukraine, and her fascination of wild equids and the similarities in behaviour between wild, feral and domestic horses has formed the basis of her research. Janne has conducted a number of research projects on fear reactions, habituation and training of horses. Her current research focuses on (i) maternal influence on the development of fearfulness and learning capacity in foals, (ii) social behaviour and welfare in relation to housing and management, and (iii) human-animal interactions.

Prof Martine Hausberger is director of research at the CNRS (French National Research Center) in the "Human and animal ethology" research unit of the University of Rennes. Her research, centred on the study of behaviour in a comparative approach, has led her to work on birds, dolphins, primates and horses in a variety of countries (Germany, Australia, New Zealand, Britain). She has initiated the research in horse ethology at the University of Rennes in the 90's, research that currently broaches the questions of horse-human relationship, learning and education. An important part has been devoted in the last few years on welfare assessment in horses with the supervision of 5 doctoral theses on the topic since 2007. M. Hausberger is author or co-author of more than 180 scientific publications and was awarded the Bronze medal of the CNRS in 1991 for her scientific achievements. The research group she leads in Rennes has a large international recognition in the field of horse behaviour. She has initiated continuous education in horse ethology in 1995 which has led to the university degree "Ethology of horses" of Rennes University in 2007, which trains about 15 professionals and private persons every year.

Dr Elisabetta Palagi has been studying primates spanning strepsirrhines and haplorrhines, including monkeys, apes and humans since 1992. Her studies have been carried out under both controlled and wild conditions. She holds a master's degree in biology, a Ph.D. in evolutionary biology, and a solid publication record on a wide array of topics bridging sociobiology, psychology and anthropological sciences. Among others, she has demonstrated individual recognition in lemurs and their use of multimodal signaling. She has also extensively investigated the functions and evolutionary significance of play, conflict management and resolution in social groups, and the behavioral patterns underlying emotional contagion and empathic abilities in human and nonhuman animals. Outside the primate order, she has focused on canids (dogs and wolves), meerkats, seals and horses. Together with Gordon Burghardt, Marc Mengel and Sergio Pellis, she has led a Working Group on play (play as a window into cognitive evolution and the rules of sociality) at the National Institute for Mathematical and Biological Synthesis (University of Tennessee, USA; *http://www.nimbios.org/workinggroups/WG_play_participants*). She is the President of the Italian Primatological Association (API) and committee member of the Italian Ethological Society (SIE). She works at the Natural History Museum, University of Pisa (Italy).

Dr Angelo Telatin is an international instructor Fellow of the British Horse Society, Associate Professor of Equine Science at Delaware Valley University, and Council member of the International Society of Equitation Science. Dr Telatin specializes in the application of learning theory to horse training and has earned his PhD in veterinary science at Pisa University. His recent research focus on the implementation of Differential Reinforcement techniques in equine training, to decrease avoidance behaviour in horses

and improve equine welfare. In addition to his academic achievements, Angelo is an accomplished rider in both show jumping and dressage, earning himself many championships and with his students. Recently he can be found riding bridleless at local shows and events.

After qualifying from the University of Cambridge Veterinary School in 1983, **Dr Pat Harris** completed her PhD at the Animal Health Trust in Newmarket into the Equine Rhabdomyolysis Syndrome. She joined the WALTHAM Centre for Pet Nutrition in 1995 and is responsible for the research carried out by the WALTHAM Equine Studies group in collaboration with experts at institutes and universities around the world. This research provides the science behind the SPILLERS, BUCKEYE - NUTRITION and WINERGY brands. She is also an Adjunct Professor of Equine Studies at Virginia Polytechnic Institute and State University, an Honorary Research Fellow at the University of Liverpool, a Visiting Professor in the School of Animal Rural and Environmental Sciences Nottingham Trent University and an Adjunct Professor at University of Queensland Australia. Pat is an European Specialist in Veterinary and Comparative Nutrition, in addition to being a Past President of the British Equine Veterinary Association. She is a member of the board of American Academy of Veterinary Nutrition and the secretary/treasurer of the US based Equine Science Society as well as the President of the European Society of Veterinary and Comparative Nutrition. Pat is also a member of the Scientific Advisory Group to the British Equestrian Federation's World Class Performance team and a member of the Veterinary Advisory Committee to World Horse Welfare. She is the author or co-author of over 500 scientific papers, abstracts and book chapters.

Dr Rebecca Gimenez published the first textbook on Technical Large Animal Emergency Rescue (Wiley-Blackwell) in 2008. A past Biology adjunct professor, her current scientific research interests include a national (USA) survey of trailer accident causality; animal physiological responses to Technical Rescue procedures and equipment; improving fire prevention standards for animal facilities; and investigations into undernutrition in horse neglect cases. She serves as an advisor for numerous graduate and veterinary school students, and hosts TLAER working students at her farm in Georgia. She is past member and Logistics Officer for National Veterinary Response Team (formerly VMAT-2), she retired (2016) as a decorated combat veteran and Major, Signal Corps, US Army Reserves. Rebecca holds a BSc? in Biology from Wofford College and Ph.D in Animal Physiology from Clemson University. She gives training in Technical Large Animal Emergency Rescue (TLAERTM) techniques across the US and internationally. She is a Principal member of the Technical Committee of the NFPA Standard 150 – Animal Housing and contributes to numerous other NFPA committees and others defining technical competencies for large animal rescue around the world. Her expertise in research and development of numerous technical procedures and techniques has been honed by teaching her privately owned animals to participate (lay down on command, lifted in slings) without sedation. They have taught her so much about behaviour in TLAER situations – both good (useful behaviours) and bad (destructive and dangerous ones.) She has published numerous critiques, protocols and refereed journal articles on a variety of technical subjects in large animal disaster and emergency rescue. She has authored chapters in several veterinary textbooks, contributed to numerous lay and professional publications, and maintains a Facebook TLAER study group with over 11,000 global students in applied large animal rescue. She owns and trail rides her 6 horses using Natural Horsemanship methods. She is active in various Horse organizations - especially on disaster preparedness, large animal cruelty and trail riding / greenspace issues.

Marco Pagliai is a horse trainer and during his carrier has collaborated with many wellknown trainers around the world. Consequently, he has studied and has been exposed to a variety of training and taming methods. Currently, his work focuses mainly on the re-training of horses suffering from problem behaviour. Since he came across and started studying the application of Learning Theory in horse training, he has been able to understand how to train horses correctly, and to deal with many unsolved and difficult questions. In this way he has improved his ability to communicate with those beautiful animals, the horses. His aim is to enhance the horse-human relationship using his scientific knowledge in Learning Theory as a driving force.

Building bridges between theory and practice: how the equine assessment and research questionnaire (E–BARQ) brings researchers and practitioners together

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Training and management practices greatly influence equine behaviour, which in turn impact upon horse welfare. Better horse management and training practices mean more likely favorable behaviour and positive welfare outcomes. While equitation science has made great research inroads, elucidation, extension and incorporation of what defines 'good' practice requires widespread understanding and grassroots incorporation in order to facilitate widespread change. What is needed now are large scale data investigating behaviour, training and management practices across various disciplines, breeds and countries. In order to define and incorporate good equine training, mental state, housing and behaviour, we need to measure these parameters over time with a validated tool.

E-BARQ, a longitudinal survey, provides a means to measure horse management and training. By investigating how changes in these factors affect horses' mental state and behaviour, we can act to improve welfare across a wide demographic. Standards of horse welfare remain discouragingly low when compared to their canine counterparts and exposing these shortcomings is the first step to making real and lasting changes. It is important that such an undertaking is done in a collaborative way with all stakeholders contributing and benefitting, including researchers, veterinarians and practitioners as well as owners and riders. E-BARQ provides incentives to owners to engage with the tool by offering feedback in the form of a comparison chart, comparing their horse's behaviour to the whole population. Owners can see how changes in their training and management are influencing their horse's behaviour and performance over time. Researchers and veterinary practitioners will benefit from the large database of information available and riders and coaches will be able to track their training progress. In this workshop delegates will have the opportunity to consider how each stakeholder group will both benefit from, and contribute to, the success of E-BARQ as a tool to measure and optimize horse welfare globally. Delegates will be encouraged to consider E-BARQ from community aspects other than their own and question how they can drive and implement change in the equestrian community as a whole. To improve horse welfare, we need to engage grass-roots riders and owners. The majority of domesticated horses are under the care of this group and while considerable research has focused on the elite level riders and horses, little has focused on this important demographic. At the conclusion of the conference, delegates will be provided with a set of explanatory/invitation emails for distribution to their particular stakeholder group members. This will assist with E-BARQ's initial reach and the dissemination of future results. By inviting a wide and diverse group of individuals to participate and contribute towards E-BARQ - we ensure both good quality data and the best possible opportunities to improve horse welfare on a large scale. Making lasting, positive changes in horse welfare cannot be achieved by scientists or practitioners alone, it is the job of all those involved in the equestrian community to contribute and work towards this common goal.

Lay person message: This workshop is designed to give delegates an insight into how the Equine Assessment and Research Questionnaire (E-BARQ) can, when adopted by researchers, practitioners, riders and horse owners, make positive and lasting impacts on horse welfare. Participants will have the opportunity to input their ideas and receive feedback during and after the workshop.

Keywords: Equitation Science; equine behaviour; welfare; training; horse management.

Emerging technologies and methods for non–invasive acquisition and analysis of physiological signals: what can heart rate variability (HRV) reveal about the horses' inner state?

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A horses' heart rate at rest typically ranges from 15 to 40 bpm, depending on many factors, including how the heart rate is recorded, the external environment, the time of day, arousal, hydration status and when taken in relation to time of feeding. When measured with a stethoscope or a heart rate monitor it may appear that there is relatively little variation in heart rate over time. However, ECG recordings which show individual beats and allow calculation of beat to beat heart rate (inter-beat intervals (IBI) or RR intervals), reveal a subtle pattern of variation in instantaneous heart rate over time. This is referred to as heart rate variability (HRV). Techniques to measure pulse rate variation were developed with advances in electronics and digital signal processing in the 1960's and lead to an explosion of interest in HRV in health and disease. Heart rate is controlled by the sino-atrial (SA) node. The primary inputs to the SA node that induce beat to beat variations in rate are respiration, blood pressure and thermoregulation but stress, hormones, electrolytes, acid-base balance, activity, eating, sleep, arousal and disease are also modifiers. The primary inputs originate from activity of the sympathetic (SNS) and parasympathetic nervous systems (PNS). In simple terms, increased SNS activity and or decreased PNS activity leads to decreased HRV. The main methods for analysing HRV are time domain, frequency domain and non-linear techniques. Whilst on one level collecting and analysing data to generate HRV indices is simple, there are many requirements that if not met can lead to a high risk of artefacts and unreliable conclusions. In horses HRV has been used to study behaviour/equitation (including stress, human-horse interaction, massage, nosebands, hippotherapy, transport and head and neck position), pregnancy, the effects of exercise and disease. Current technology offers exciting new opportunities for monitoring vital signs in horses. Moreover, commercial systems are emerging for research studies, primarily in laboratory settings, for improving performance as well as monitoring of patients suffering from specific diseases. Nowadays research and free-living environment applications require a more robust and reliable monitoring of subjects both in natural and laboratory conditions, either for pathological or behavioural investigation. Many current physiological monitoring systems measure conventional vital signs (e.g., heart rate, activity) with standard Ag/AgCl, or plastic conductive electrodes, but these are limited to a restricted set of applications. Moreover, there is a gap in developing and validating wearable physiological monitoring systems and the algorithms that convert data into useful and actionable information for medical management, welfare monitoring and performance optimization. Recent technological advances in miniaturized sensors, material sciences, robust embedded computing, signal processing and artificial intelligence are empowering state-of-the-art systems to leap forward beyond measurement and telemetry of conventional vital signs to provide "smart" and personalized decision aids to monitor and improve health and performance. Such "smart" physiological monitoring systems will use real-time physiological data fusion to predict changing status (improving or worsening) and will eventually allow ubiquitous use in every-day activities, health care monitoring, as well as use in controlled environmental conditions.

Heart Rate Variability (HRV) analysis has received a growing attention from clinicians

and physiologists, as a powerful tool to assess autonomic nervous system (ANS) activity. Standard methodologies used to investigate HRV consist of time and spectral analysis methods. Their effectiveness in understanding the autonomic control of R-R interval fluctuations and in the prediction of cardiovascular diseases, as acute myocardial infarction, is already known.

However, if spectral analysis of HRV is a powerful tool to assess the regulatory mechanisms of the sympathetic and parasympathetic subsystems over the heart, this technique requires the stationarity of the signals. A wide range of physiological studies imply the processing of non-stationary signals, e.g., tilt tables, stress tasks, emotional stimulation. For that reason several time-frequency and time-varying methodologies of the HRV analysis have been introduced.

Research studies have revealed non-linear aspects of the dynamic interaction between sympathetic and parasympathetic nervous systems. Currently, non-linear methodologies applied to cardiovascular signals are considered to be a strong complement to standard time-frequency analysis. The prominent non-linear techniques can be grouped into four main families: fractal measures, entropy and complexity metrics, symbolic dynamics methods and Poincaré maps. Moreover, multiscale approaches are used, based on the rationale that complex systems generally reveal long-range correlation structures over multiple temporal scales. Methodological advances in estimating the complex behaviour of physiological systems have been directed towards the study of multichannel recordings (e.g., cardiovascular, respiration, blood pressure signals). Novel research has demonstrated that multivariate approaches for the investigation of non-linear autonomic interactions often outperform univariate methodologies.

Lay message: From observing a heart rate monitor or listening to the heart with a stethoscope we get the impression that heart rate is quite regular. Analysis of ECG recordings shows that there are subtle patterns of variation in rate referred to as heart rate variability (HRV). This variation or sometimes lack of variation in human medicine reveals important diagnostic information about health and disease. Analyse of this variation may also provide an insight into behavioural states but this is still a controversial area. This type of analysis is complex and whilst commercial systems do exist which provide an estimate of HRV they are open to artefact and being misleading.

Keywords: behaviour; health; disease; ECG; technique; analysis.

"Does not insist enough to require that the soldier acts on the horse's mouth the smallest actions that he can, keep a light hand as far as it is possible and move forward the fists whenever the horse needs to stretch the neck"

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 106)

Caprilli's heritage: innovation and horse welfare behind the historical perspective

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If we go back to the work of Capt. Federigo Caprilli, the first idea is the contribution that he gave to the progress of show jumping technique. However, this can be also considered as a mere "byproduct" of his will to prepare good horses – and riders – for the Italian cavalry, as stated by his pupil and friend, Paul Rodzanko. The general idea was to follow the horse in its natural propensity, and to work with him. This tendency does not begin in the early '900, and did not die with Caprilli: on the contrary, it is still on going. In a larger perspective, a great moment for the progress in horses study started with illuminism, about 100 years before Caprilli. In 1762, George Stubbs painted the famous Whistlejacket, an example of realism confirmed by the publication of his "Anatomy of the horse", in 1766. In 1761, the first (private) veterinary school was held in Lyon; in 1769 Diderot and D'Alembert published the tables of the Encycolopedie related to Equestrian art. In the same years, the horse movement was not deeply understood (see Baronet, painted by the same Stubbs in 1760, but also the Epsom Derby, painted by Theodore Gericault in 1821). The work of Muybridge changed this part of the framework in 1878. Caprilli, starting from this "new" knowledge and liveliness, through observation was able to indicate a new way to approach horse's cooperation with humans.

Caprilli was then a product of its time, and a bold innovator. This is, in my opinion, his true legacy together with carefulness about horse's welfare. Today, innovation in horse's science involves the utilization of new technologies, *e.g.* the use of inertial platforms, thermographic imaging, GPS, and a number of other devices already in use in other science areas and for other sports. On the other hand, the respect for the welfare of horses involves a deeper look to the real needs of this species, without anthropocentrism and considering the possibility to change some "traditional" features of horse's market. These are the challenges we will face in the next years.

Lay person message: The respect for the welfare of horses requires attention for their needs without anthropocentrism to change some "traditional" features of horse's management. Caprilli was an innovator for the horse welfare and in the light of his work we should continue to improve the equitation science research, even using the new technology

Keywords: Caprilli, innovation, horse welfare.

> *"One should always exploit the natural instincts of this animal, following its movements and gaits and provoking the least annoyance possible on its mouth, kidneys and chest. Whatever comprises bending, forced positions and forced balances must be abolished."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 71)

Clever Hans lecture: just how good are horses at reading human-given cues?

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For most psychologists Clever Hans provides an important reminder of the perils of unconscious cuing in research. For those of us interested in equine cognition, he also, and perhaps far more interestingly, demonstrates the amazing ability of horses to read subtle human body language. For domestic animals such as horses, humans represent significant social partners and it would therefore be adaptive to be able to utilize human-given cues. In this talk I will present an overview of the studies we have conducted exploring horses' sensitivity to a range of human signals, focusing on our recent research showing that horses are able to respond appropriately to human facial, body and vocal cues of emotion and use memories of emotional expressions to guide future interactions with specific people. Horses' abilities to use human attentional and communicative signals successfully in social decision-making processes will also be discussed. Taken together, these results raise interesting questions regarding the origin of these abilities, the relative importance of lifetime experience and evolution, and how this information can be applied to management practices.

Lay person message: Clever Hans was a horse that people thought could solve mathematical problems but was in fact, picking up on subtle and unconscious cues from the people around him. He provides an example of how good horses can be at using human signals. This talk outlines a series of experiments we have conducted showing horses are able to utilize subtle human cues to emotion, identity and attention to gain information about their surroundings and make decisions.

Keywords: social cognition; interspecific communication; equine cognition; human-animal interactions; domestication; affective processing.

> *"He had become an expert of horses and over time of knights equally. He knew how to easily discern what the one and the other could do..."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 63

Stress and learning in horses

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Stress and learning are common words in the vocabulary of most people, e.g. to express how busy one is and to discuss the (poor) state of the public school. The actual definitions of the terms are rarely considered, nor is the link between them. In this plenary, I will argue that both stress and learning are key terms in equitation science. Horse welfare (including good training, good feeding, good housing, good mental state, good health and appropriate behaviour) is related to reduced stress levels which in turn paves the way for optimal learning. Before considering stress further, it is necessary to reflect on the definition of the term. Stress is a ***state***, resulting from a ***stressor*** (i.e. an internal or external event, involving a real or potential threat to the maintenance of homeostasis; the inner balance of body). ***Stress responses*** are all the behavioural and physiological responses aiming to re-establish homeostasis. Thus, the state of stress is reflected in the combined changes in behaviour, nervous system, hormones and immunology. The body's stress responses are ideal to overcome acute stressors, such as an attack from a predator, an aggressive conspecific, or short-term extreme weather conditions. Energy is mobilised and delivered to muscles and the most vital organs, pain perception is blunted and expensive anabolic processes are suppressed until the emergency situation is over. From this perspective, stress reactions are adaptive. On the other hand, we all know that stress can make us ill. This is because the body's stress reactions have evolved to overcome acute, physical stressors. These are the type of stressors that most organisms are exposed to in their natural environment. Stress-induced illness occurs when the body's alarm system is activated too often and/or for too long. If the body is constantly mobilising energy through the breakdown of stored protein it leads to breakdown of muscles and results in weakness and fatigue. Other negative effects of frequent/prolonged stress include increased vulnerability to infections and gastric ulcers. It has also been documented that severe or prolonged stressors can have deleterious effects upon broad aspects of cognition, because high levels of glucocoticoids affect neurons within the hippocampus; a brain region central to learning and memory. Domestic horses can experience a wide range of internal and external stressors, including fear-eliciting and painful stimuli and lack of fulfilment of biological needs (e.g. social company, free locomotion and access to roughage), as well as psychological stressors, such as loss of control and predictability. Long-term stress of various housing or training conditions may therefore cause marked impairment of learning and memory abilities through the damaging actions of chronically elevated levels of glucocorticoids on brain structure. Optimal learning, however, requires slightly elevated arousal levels acutely, beyond which learning is inhibited. This has been described as the inverted-U relationship between learning and arousal as reflected in the Yerkes-Dodson Law. Accordingly, research has shown that fearful horses generally give poorer performance under stressful conditions, probably because of inattention to the trainer/rider because stimuli in the environment outcompetes the trainer for salience. The optimal arousal level for a specific task is related to how challenging the task is for the individual; simpler tasks can be performed successfully even at high arousal levels whereas challenging tasks are typically performed more successfully at lower arousal levels. Thus, there is a fine line between elevated stress levels sufficient for learning and responding compared to higher stress levels that inhibit learning. The skill of training using a paradigm of negative reinforcement involves applying this pressure gradient only to the level of optimal learning. Awareness and identification of this threshold is an important area of study in equitation science and central to this are two major components of psychological stressors: ***predictability*** (in horse training classical conditioning provides cues that

predict certain events) and ***controllability*** (where the animal is able to manage its behavioural outcome, e.g. give a suitable response to reduce pressure from a rider's legs or reins). It has further been suggested that arousal and affective states influence the efficiency of each of the four quadrants of operant conditioning, and recent results demonstrate that horses in a positive emotional state show enhanced cognitive flexibility in terms of greater flexibility in the extinction phase of instrumental learning. There is documentation from several species that enriched environments and sensory stimulation can cause changes in the amygdala and orbitofrontal cortex leading to decreased anxiety and vigilance in both humans and animals. Additionally, studies in a range of mammals has documented improved brain hippocampal neurogenesis during housing conditions with resources and the possibility to perform locomotor behaviour. It is speculated that these positive effects on the brain is an antidote to stress and thereby enhance learning and memory. Recent results in horses showed that curiosity, i.e. the tendency to manipulate novel objects, was positively correlated with performance in both negatively and positively reinforced learning tests. Collectively, the current literature demonstrates that stress and learning are interlinked and that optimal training depends on good horse welfare, optimal arousal levels and positive affective states.

Lay person message: Horse trainers and riders are dependent on their horses' ability to learn the many different tasks required in equitation. Learning performance does not only depend on genetic inheritance but is largely affected by the daily environment. Stress resulting from e.g. lack of fulfilment of biological needs, such as company of other horses, access to roughage and free locomotion, do not only lead to impaired health and reproduction but also impaired learning performance. Optimal training is therefore dependent on good horse welfare.

Keywords: arousal; cognition; fearfulness; performance; stressor; training.

"In order to teach well, it is required that riding instructors know, and not only think to know."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 124)

O1

Quantifying the stress response of horses bitted for the first time

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Recent research has identified a stress response associated with items of tack in ridden horses yet the effect of first introduction of tack on the horse's mental state has not been studied. This study aimed to assess the stress response of naïve horses to traditional bitting practices using behavioural and physiological measures. Eleven naïve horses (mean age 3.54 years ±0.52) were bitted using a traditional method for three consecutive days. Bits were presented from the left hand side with the handler facing forwards and their thumb placed in the left corner of the mouth. The horses remained tied up for the first minute post bitting and then loose in the stable for five minutes. Stress response was assessed via infrared thermography images of the left eye (ET) taken immediately prior to bitting (baseline) and at 0, 1 and 5 minutes post bitting. Heart rate (HR) values were recorded at the same timepoints and during the bitting process. Qualitative behavioural assessment was conducted for the first minute post bitting and 'stress' was graded on a 1-5 scale using validated stress indicators. RM ANOVA was used to test for differences between the measured timepoints on each day and between the three days. HR showed a significant increase between baseline and all other timepoints on Day 1 ($F=27.078$, $df=4$, $P<0.001$), Day 2 ($F=16.348$, $df=4$, $P<0.001$) and Day 3 ($F=9.463$, $df=4$, $P<0.001$). HR increase during bitting significantly decreased over the three days ($F=5.083$, $df=2$, $P=0.018$) as did HR increase immediately after bitting ($F=9.332$, $df=2$, $P=0.002$). No significant difference in ET was seen after bitting from baseline, on any day or over the three days ($P>0.05$). No significant change in behaviour score in the first minute post bitting was seen over the three days ($P>0.05$). The introduction of a bit elicited a physiological stress response. Horses showed less fluctuation in HR on Day 3 compared to Day 1 indicating some habituation occurred. HR still increased significantly on Day 3, further research could investigate the time required for complete habituation to bitting and the consideration of other methods to introduce the bit, such as operant conditioning. ET data showed no significant difference, but it is possible that this method needs increased imaging frequency to accurately reflect acute stress responses. Qualitative behavioural assessment during exposure to novel scenarios may not allow true representation of stress responses, physiological measures are required to provide a more objective assessment.

Lay Person Message: The introduction of the bit to a young horse is a potentially stressful procedure. Horses do become more accustomed to this when it is performed regularly but the length of time needed to completely habituate to this process is not currently known. Relying solely on the visible behaviour of the horse during bitting may not give a full picture of how the horse is experiencing and coping with the procedure.

Keywords: equine; bit; behaviour; stress; training; welfare.

Approach to the gate: examining conflict behaviour in throughbred racehorses

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Training based on an understanding of learning theory may influence athletic success, prevent injuries and improve human-horse relationships in the racing industry. Gate training is an essential component of training young Thoroughbred racehorses. Getting a good break from the start gate is critical in the outcome of the race result; therefore, gate training is an important aspect of race preparation. Horses with poor gate training may not only be at a competitive disadvantage, but may also pose a safety risk to themselves, the jockey and gate staff. The aim of this study was to explore the prevalence of conflict behaviours (CB) demonstrated by horses and to evaluate the most common form of assistance currently used by gate staff. Video footage was obtained of 2-5 year old racehorses (n=283) during gate training over an 8 week period at Woodbine Racetrack, Canada. The horses were recorded from 50ft away from the gate until they were either successfully loaded, or loading attempts were abandoned. Retrospective analysis of the video footage recorded total time taken to load, any CB demonstrated, and any extra assistance required. A score (0-2) was assigned to each horse depending on the number of CB recorded. Results showed a positive linear regression trend between the time taken to enter the start gate and the number of previous attempts entering the gate (y=0.0021x + 2.7298); suggesting horses reluctant to load are not improving with current training techniques. 71% (n=160) of the horses included in this study demonstrated one or more CB, (total of 299 CB). Stopping for more than 2s was the most prevalent CB documented (n=148, 49%), followed by backing up (n=74, 25%), swinging (n=47, 16%), rearing (n=17, 6%) and kicking (n=13, 4%). Although more fillies than colts or geldings were disqualified due to dangerous behaviour or the rider falling off, sex did not play a significant role in frequency of demonstrating CB (chi squared test, P=0.051). When considering the use of human assistance as a reaction to reluctance to load, gate staff used an artificial aid, such as whipping, over 40% of the time. Learning is delayed by poor timing of reinforcement, conflicting reinforcement or fear. A better understanding of learning theory by racetrack gate trainers may allow more effective gate training of young racehorses and result in the demonstration of fewer CB. Further research is required to determine effective gate training methodology.

Lay person message: In order to win a race, thoroughbred racehorses must have a good break out of the starting gates. 283 racehorses were video recorded to examine their behaviour entering these start gates and 71% of them demonstrated unwanted behaviours, which have the potential to result in injury to the racecourse staff, jockey or the horse and furthermore may result in disqualification from the race. Future research is required to determine the best training method to gate train young racehorses.

Keywords: racehorse; sex; behaviour; start gate; conflict behaviour.

Horses' learning performance when using different training schedules (daily vs. every three days training sessions) to train novel tasks via negative reinforcement

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Riders commonly use their 'gut feeling' when deciding for a given horse how frequently to train a specific learning task, but little objective data exists regarding the optimal time interval between repetitions of a learning task. The primary aim of the present study was to assess horses' speed of learning novel tasks when trained at different intervals via negative reinforcement and shaping. Twenty horses aged 2-24 years previously unfamiliar with these tasks were trained either daily (D, n = 10 horses) or every third day (3rdD, n = 10) to lower the head on poll pressure (HL), back up from neck pressure (BU), and to step forward upon pressure at the fetlock (SF). Except for the first training session (3 minutes per horse), each training session lasted 1 min, allowing for 3-5 repetitions per task and session. Training success was scored using a 6-point scale (e.g. 0: no response or a response that contrasts with the task such as moving into the opposite direction; 1: moving head slightly (<1cm) downwards upon strong pressure), 6: moving head down immediately with the poll dropping below the elbows upon light pressure). Additionally, heart rate, time and pressure required to respond, and behaviour was recorded. Mixed model analysis showed that horses significantly improved performance under both training schedules (e.g., 3rdD time to correct response: first (7.6±0.7 sec) vs. tenth session (2.8±0.7 sec) $t_{845}=6.82$, $P<0.05$). When comparing performance under the two training schedules after four training sessions, horses showed neither according to the scores nor the time or required pressure to respond, any differences in learning progress ($P>0.05$ for all variables and all three tasks). In the end of the 28-day study period, there was in spite of the different numbers of training sessions (10 vs. 28) likewise no significant difference in learning progress or time or pressure required to respond for any of the tasks between horses of the two training regimens (e.g., HL-D: 5.4±1.2 vs HL-3rdD: 3.8±1.0 scores, $P>0.05$; $t_{32}=-0.39$). Frequency of yawning, chewing and licking did not differ between the training schedules (all $P>0.05$), but chewing ($P<0.05$) occurred more frequently in earlier rather than later trials. Results suggest that initially, faster progress in learning a novel task can be obtained with daily training. However later, within the same time period, similar levels of training progress can be obtained, if there are longer breaks between training rather than training daily.

Lay person message: Results of the present study suggest, horses do not 'forget' what they have learned in a novel tasks, if they are trained only every third day rather than daily in that task. Allowing horses breaks of two days between training sessions rather than training daily results in similar learning progress over a period of 28 days, and such a training schedule might be considered to make more efficient use of trainers' (and horses') time.

Keywords: training frequency; negative reinforcement; shaping; learning.

The effect of equine visual adaptation on obstacle negotiation under different light levels

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Visual adaptation to different levels of ambient light requires changes to occur in the photoreceptors within the retina. Adaptation to low light levels (dark adaptation) takes approximately 20 minutes in the horse. In the domestic environment artificial lighting and/or rapid movement between differently lit areas may result in a lag in visual adaptation and a decrease in visual judgement. Light levels have also been found to affect arousal as indicated by heart rate (HR). The aim of this study was to assess the impact of sudden changes in ambient lighting on the time taken to negotiate an obstacle course and the effect of different light levels on HR. Trials were conducted within an indoor arena (40m x 60m) with areas that could be lit independently. To enable dark conditions to be generated, trials were conducted mid-December-midFebruary (16.00-18.30) in the UK. Horses (n=10) were trained to walk freely though a pre-constructed alleyway (1.8m wide, 12m long) within which were placed four items to circumnavigate (shavings bales; upturned muck tray / skep) and a raised pole (20cm) to step over. The configuration of the obstacles was varied to reduce the effect of learning on performance. All horses underwent pre-test training in both dark (D) and light (L) conditions before the visual adaptation trials. Light levels were measured using a handheld LCD light meter: L=41-42 Lux; D=0-0.5 Lux. The D/L adaptation trials were conducted using a cross-over design with half the horses (n=5) starting with D adaptation trials, half (n=5) with L adaptation trials. In both conditions the horses were fitted with a heart rate monitor. The horses were adapted to the D/L conditions for 20 minutes prior to negotiating the obstacle course in the same light, followed by the opposite light condition. The effect of prior visual adaptation on time and HR was assessed. Horses took significantly longer to negotiate the obstacle course in the dark following light adaptation (mean 13.1 ±10 s) than following dark adaptation (mean 8.4 ±2 s) (Wilcoxon test: z=-2.94, P=0.013). A significantly lower HR was recorded for trials in the light following dark adaptation (74.5±21.11bpm) than for trials following light adaptation (102.45±31.08bpm) (paired samples t-test: t=2.27, df=9, P=0.05). The results highlight the importance of allowing time for visual adaptation in particular in low light levels and that low light levels may reduce arousal. Both findings have implications for safety, performance and management.

Lay person message: If you go quickly from a well-lit environment to a dark area it will take about 20 minutes for your eyes to adapt to enable you to see clearly. You may also find that darkness induces relaxation. The same was found in the horse. When negotiating a simple obstacle course in the dark, a 20 minute period of dark adaptation resulted in them being able to complete this more quickly than when they had previously been in a well-lit area. This need for time to visually adapt to different light conditions should be considered during management and training.

Keywords: Vision; scotopic; photopic; obstacle avoidance; light; visual adaptation.

Investigation into thoracic asymmetry in ridden horses

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Correct saddle fit for horse and rider is important to optimize athletic performance. An ill-fitting saddle can have deleterious effects on a horse's musculoskeletal structure, causing pain and influencing the horse's work ethic. Saddles are traditionally fit assuming anatomical symmetry, but if the horse's body is asymmetrical, then uneven pressure points will exacerbate the problem, potentially leading to long-term muscle atrophy. The aim of this research was to determine if asymmetry exists in the musculoskeletal structure of ridden horses. Records of past saddle fits (n=492) were obtained from a local saddle fitting company. A wither tracer tool was used to obtain measurements of wither shape at thoracic vertebrae T3 and T7. Each tracing yielded four standardized points (two on the left and two on the right) measured in millimeters from the horse's midline. Descriptive assessments of shoulder, wither, and back shape were recorded along with demographic information on both horse and rider (age, gender, level, breed). A Wilcoxon signed-rank test compared the means of the eight wither shape measurements. A GLIMMIX procedure identified relationships between the eight wither shape measurements, descriptive assessments, and horse and rider demographics. Measurements from tracings taken on the left side of the withers were invariably larger than those on the right (e.g. 121.7±12.2mm vs. 118.6±12.7mm for the first T3 measurement on left side vs. right side; $t(481)=5.47$, $P<0.0001$). There was a trend for draft horses to have larger T7 measurements ($F(6,1)=2.03$, $P=0.058$). Shoulders were described as sloped more often in Arabians and Thoroughbreds ($F(6,1)=2.69$, $P<0.014$), while Arabians and draft horses were described as having shorter withers than other breeds ($F(6,1)=5.05$, $P<0.0001$). Arabians also had a smaller saddle support area than other breeds ($F(6,1)=3.22$, $P<0.018$). Higher level dressage and jumping horses tended to stand with their left shoulder more forward than horses of other disciplines ($F(7,1)=1.98$, $P=0.053$). Shoulder muscles were described as smaller in stock-type horses ($F(6,1)=2.25$, $P<0.02$) but increased in size with increasing age of the horse ($F(22,1)=2.35$, $P<0.0004$). These results clearly show that horses have more developed musculature on the left side of their shoulders than the right, with significant breed differences in shoulder, wither and back shape. This asymmetry may be due to genetics, environment or training. These results should be taken into consideration when fitting saddles to horses to ensure freedom of movement under the rider and reduce the possibility of uneven pressure points leading to pain and back problems.

Lay person message: Traditionally saddles are manufactured and fit assuming horses are symmetrical in their skeletal structure and musculature. However, this study shows that horses are asymmetrical, particularly having larger left shoulders, with specific breed differences in measurements affecting saddle fit. Fitting saddles symmetrically may not be in the best interest of the horse if it causes pressure points leading to pain and discomfort in the ridden horse.

Keywords: asymmetry; muscle development; saddle fit.

The effect of separation on equine behaviour, heart rate and heart rate variability whilst exercised on a horse walker

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Horse walkers are a convenient method of exercising horses, however due to the isolating nature of these exercisers and a lack of research in this area, little is known about how stressful horse walkers may be for equines. The aim of this study was to analyse signs of stress in equines, when they were exercised on a horse walker separated in comparison to when they were with a companion. Sixteen horses and ponies of mixed breeds, sexes and ages from the Writtle University College Equine Training and Development Centre were grouped into preferred associate pairs. The study used a Molenkoning six-partition automatic track system horse walker. The horses were habituated to the walker for 8 weeks before the study, exercised at least 3 times a week. Heart rate (HR) and heart rate variability (HRV) were measured using a Polar® v800 HR monitor. Stress behaviours were recorded continuously using iPhones fitted to the partitions of the walker. Behaviour scores (BS) were calculated as a percentage of time stress behaviour was displayed. Data was analysed using Polar® Flow and Kubios HR software. Mean HR (df=15, tdep=+/- 2.13, P=0.033) and BS (df=15, tdep=+/-2.13, P=0.000) were significantly lower when the horses were with a companion compared to when they were separated. Mean HRV significantly increased (df=15, tdep=+/-2.13, P=0.000) when the horses were with a companion compared to when they were separated. Furthermore, there was a significant difference in LF/HF ratio when the horses were with a companion (df=15, tdep=+/- 2.13, P=0.000) compared to when they were separated (df=15, tdep=+/-2.13, P=0.000). Additionally, all horses reached a physical anaerobic state equivalent to that of racehorses galloping (70-100% of their maximum HR during both treatments) whilst walking. The horse's flight response, (LF/HF ratio increase) was reduced when they were with a companion. The results demonstrate that separation does have a significant effect on equine stress whilst exercised on a horse walker, which is a welfare concern. Confining a flight animal in a small enclosed space with no escape route may cause a learned helplessness state, evidenced by the subtle behaviours observed in the trial. If horse walkers are to be used as a labour-saving management tool, then stress may be reduced in horses by the addition of a preferred companion to improve welfare.

Lay person message: Horses are a social species and therefore it is common for them to become stressed whilst they are separated. In this study 16 horses were monitored for stress whilst exercised on a horse walker, both on their own and with a known companion. It was found that in both situations the horses were subjected to significant stress on the horse walker, but less so with a companion. If horse walkers are to be used, then it is better for the horse's welfare if they are accompanied by a known friend.

Keywords: horse walker; stress; separation; behaviour; heart rate; welfare.

Kinematic analysis of rider position on a dressage simulator compared to a live horse

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Biomechanical studies of the rider are becoming more common, and frequently use a riding simulator in place of a live horse. To date there has been limited literature on the differences seen between the two methods, particularly with reference to established horse-rider partnerships. A group of 12 female riders were fitted with joint markers at the centre of the coxofemoral, femorotibial, tibiotarsal, glenohumeral and humeroradial joints on the lateral view, on the boot over the fifth phalange, and on the hat, above the ear. Riders were videoed at 500Hz from both left and right for three stride cycles of sitting trot on both their own horse (OH) and on the Racewood dressage simulator (SIM), both in a dressage saddle. Quintic Biomechanics v29 was used to measure the upper arm inclination, lower limb joint angles and the deviation of both the upper body (hip to ear) and lower body (hip to ankle) from the vertical and a mean taken. Asymmetry was calculated for each variable as the difference between left and right measurements. The paired t-test was used to compare both absolute angles and asymmetry values between the conditions. The upper arm inclination was significantly greater in SIM ($t=-3.379$, $df=23$, $P=0.003$). The coxofemoral angle was found to be significantly larger in SIM ($t=3.378$, $df=23$, $P=0.003$) and the lower body deviation from the vertical was significantly lower ($t=-2.836$, $df=23$, $P=0.009$) in SIM. All other measurements showed no significant difference between conditions ($P>0.05$). Tibiotarsal angle asymmetry was significantly greater in SIM ($t=-2.551$, $df=11$, $P=0.027$) and lower body deviation asymmetry was significantly greater in OH ($t=2.348$, $df=11$, $P=0.039$), all other measures showed no difference in asymmetry between the conditions ($P>0.05$). Upper arm inclination differences between conditions can be explained by arm movement in response to movement of the head and neck on the live horse. The riders' coxofemoral angles decreased and legs moved further in front of the vertical on the live horse, as well as showing greater asymmetry in lower leg positioning. This could represent the effect of inertia on the riders' ability to maintain their own posture. Previous studies have indicated higher aerobic demands on the on the live horse compared to the simulator, this could be due to the additional muscular effort required to maintain position. Studies drawing conclusions about rider posture using a riding simulator should take these effects into account.

Lay person message: The use of riding simulators for both research and training of riders is widely popular as it removes the influence of the horse and allows the performance of activities which may contravene horse welfare. There are however differences in both arm and leg position of riders between the simulator and their own horse which may make it difficult to draw accurate comparisons between the two.

Keywords: training; biomechanics; rider posture; dressage; simulator.

Pilot study: will a skilled rider increase or decrease horse asymmetry while riding on the vertical?

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Locomotor symmetry is described in terms of absolute straightness, in which biomechanical variables are equal on the left and right sides, and relative straightness, in which asymmetries are equal but mirrored when travelling on curved lines. The pursuit of straightness is an on-going challenge for dressage riders who attempt to improve the horse's straightness in spite of their own laterality (handedness). The aim was to determine whether horses would move more symmetrically when unridden and unrestrained or when ridden in a dressage competition position (bridge of nose at the vertical). Seven high-level, dressage warmblood horses, deemed free of lameness, were measured with and without riders in walk and trot on a force-measuring treadmill (2 x 4-7 trials per horse). They were ridden by their usual riders in their usual tack (bridle with snaffle). Difference variables were calculated, subtracting the right value from the left, for stance lengths, stance durations, protraction/retraction distances, ipsilateral limb tracking (how the horses positioned the hindquarters laterally relative to the forehand) and vertical ground reaction force peaks. Absolute differences for these variables were analysed using mixed models, with horse as random effect, unridden/ridden as fixed effect and controlling for speed. There were 6 significant differences (of 13 evaluated) for absolute asymmetry in walk that all showed increased asymmetry at riding (T-values =2.64- 3.49, df=53-59, P=0.01-0.0009): forelimb stance length, forelimb stance duration, forelimb stance protraction and retraction, hind limb stance retraction and the first forelimb force peak. In trot 4 of the 5 significant differences suggested increased asymmetry while ridden (T-values =2.26-4.12, df=52, P=0.03- 0.0001): forelimb stance length, forelimb stance duration and hind limb stance protraction and retraction. The hind limb stance length difference decreased while ridden. Thus, all but one of the significant differences pointed towards increased horse asymmetry while ridden. The symmetrical forces at trot suggest the kinematic asymmetries were not due to lameness. The greater asymmetry while ridden might be a consequence of the additional weight of the rider, the application of the rider's aids, or differences in the horse's posture, particularly in the horse's head and neck position. Additional studies including more horses and riders evaluated during various dressage exercises are needed to confirm the relevance of the results for the equestrian dressage population.

Lay person message: Riders constantly strive to improve symmetry in their horses and themselves. This study showed that a group of seven upper-level dressage horses became less symmetrical when ridden on the bit in straight line walk and trot compared to unridden with a natural head-neck position. The fact that upper-level horses were less, rather than more, symmetrical when ridden requires further study to determine the effects of the rider's weight, the rider's aids, and the horse's posture so that appropriate measures can be taken to ensure optimal welfare of the ridden horse. The findings may inform sciencebased biomechanical reasoning in equitation.

Keywords: rider; equitation; gait asymmetry.

Comparison of rider stability in a flapless saddle versus a conventional saddle

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A saddle is used to improve the rider's safety, security, and comfort, while distributing forces exerted by the rider and saddle over a large area of the horse's back. This study investigated the effects on rider stability of an innovative saddle design that differs from a conventional saddle in having no flaps, so the rider's legs are separated from the horse's ribcage only by a soft, flexible saddle pad. Five horses were ridden by their regular rider in their usual saddle and a flapless saddle in random order. Data were recorded as the horses were ridden at collected and extended walk, trot, and canter in a straight line. Spatiotemporal kinematic data were measured from 30Hz sagittal-plane video recordings. Pressure on the horse's back was measured using an electronic pressure mat with 60 Hz recording frequency. The pressure data were used to determine the position and movements of the rider's centre of pressure, which represents the centroid of pressure distribution on the horse's back. The data strings were split into strides, with 5 strides analysed per horse/gait/type. For each stride the path of the rider's centre of pressure was plotted, maximal and minimal values in the anteroposterior and mediolateral directions were extracted, and ranges of motion in each direction were calculated. These variables were transformed along the ladder of powers with the most normal transformations being selected based on plots and descriptive statistics. Anteroposterior data were normally distributed, mediolateral data were negative, inverse, square-root transformed. Data comparisons between the two saddles at the collected and extended walk, trot, and canter were explored using mixed models with gait and saddle as fixed factors, including their 2-way interaction, and with horse as random effect. Speed and stride length of each gait did not differ between saddles. Compared with the conventional saddle, the flapless saddle showed significant reductions in range of motion of the rider's centre of pressure in the mediolateral direction in all gaits (P-value range 0.04-<0.0001, T-value range=2.02- 6.67; DF=260) and in the anteroposterior direction in collected trot (P=0.04, T=2.11; DF=260), extended trot (P<0.0001, T=4.17; DF=260), and extended canter (P<0.05, T=1.98; DF=260). When riding with a flapless saddle, the more adducted position of the rider's thighs was thought to facilitate the action of the lumbopelvic-hip musculature in stabilizing and controlling translations and rotations of the pelvis and trunk. A stable rider can give aids that are more consistent and predictable for the horse.

Lay person message: The rider needs stability in the saddle both for safety and to apply consistent aids. We compared rider stability in a conventional saddle versus a saddle with a tree but no flaps. When riding in the flapless saddle the rider's position remained more centred from side-to-side in collected and extended walk, trot and canter, and had smaller front-to-back oscillations in collected trot, extended trot and extended canter. The enhanced rider stability in a flapless saddle is likely to have a positive impact on equine welfare, and the closer contact between rider and horse may facilitate applying light and consistent aids.

Keywords: rider; equitation; saddle; centre of pressure.

Can we identify back pain in horses?

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Back pain and vertebral disorders are more and more pointed out as a primary source of welfare impairment in working horses. If a global consensus exists on the impact of riding techniques and postures at work on the development and prevalence of back pain, the identification of reliable indicators of such disorders is more difficult. Scientific publications on the subject show that in most cases, the prevalence of vertebral disorders is strongly under-estimated by both professionals and owners, highlighting the urgent identification of visible indicators. The expression of back disorders can be at different levels, according to the type of disorder and to the individual affected, and are rarely specific of back pain.

Behavioural changes, in the form of chronic modification of the behavioural repertoire (emergence of abnormal behaviours: teeth grinding, groaning...) and time budget (increased restlessness, reduced locomotion), or the modification of interactive behaviours (increased aggressiveness towards both humans and congeners) might reveal the presence of back problems. Immediate behavioural and postural reactions (tail swishing, backing up, head-tossing, nose tilting...) can be observed in response to work constraints/inadapted riders' actions when ridden. Unwished behaviour when ridden can also result from a chronic state of back pain. Physical changes, such as lameness, abnormal weight distribution, more or less subtle changes in gaits, feet anatomy and orthopedic status can also reveal the presence of back pain. Last but not least, chronic neck and back postural changes may inform on the emergence of back/vertebral disorders. Because these postural alterations are elicited repeatedly, they may lead to chronic postural profiles. Our recent studies using geometric morphometry reveal the potential relationship between the welfare state, working conditions and chronic postural profiles.

Lay person message: Back disorders, if recognized as a primary cause of welfare impairment are still scarcely recognized. Most indicators are either not specific or based on subjective appreciations / unprecise behavioural description. As most working horses are prone to develop such disorders, it appears urgent to identify reliable visible signals.

Keywords: back pain; vertebral disorders; signals; welfare; working conditions.

> *"Sitting, in some exceptional case, helps gaining solidity, but generally, if it is done close to the saddle it will lighten the horse and facilitate its action; if it is pressed instead, it will obstruct."*
>
> Carlo Giubbilei "Federico Caprilli, LIfe and Writings", p. 247

O10

Application of a ridden horse ethogram to video recordings of lame horses before and after diagnostic analgesia by trained and untrained assessors

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Differentiation between alteration in behaviour which is the result of pain and that reflecting other behaviour is potentially challenging in ridden horses. A ridden horse ethogram has been previously developed and tested using trained assessors in 4 separate trials. Results showed that occurrence of ≥8 out of 24 behavioural markers is likely to reflect musculoskeletal pain. The objective of this study was to determine if the ethogram could be used to differentiate lame horses before and after diagnostic analgesia had substantially improved lameness in a larger number of horses and whether untrained assessors could apply the ethogram reliably. In phase one, video recordings of 10 lame horses were reviewed blindly by a trained assessor before and after diagnostic analgesia resolved the baseline lameness and improved any gait abnormalities seen in canter. The videos were assessed in real-time, but could be stopped and replayed. The ridden horse ethogram was applied to each horse and occurrence (yes/no) for each of 24 behaviours was recorded. After abolition of lameness, the total sum score of behaviours (Wilcoxon paired Sign: $P<0.01$), sum of facial ($P<0.05$), sum of body ($P<0.05$) and sum of gait ($P<0.05$) scores were all significantly smaller. In phase two, video recordings of 21 horses were reviewed by a trained assessor and 10 untrained assessors (veterinarians and non-veterinarians). For the trained assessor the number of behaviours exhibited by lame horses before diagnostic analgesia ranged from 3-12/24 (median 10; mean 8.9) which was significantly higher than after lameness had been abolished: range 0-6/24 (median 3; mean 3.0; Wilcoxon: $P<0.001$). For all the assessors the decrease in sum of behaviour scores after diagnostic analgesia was significant (Wilcoxon Signed-Rank: $P<0.0001$). Agreement on individual markers between the untrained assessors and the trained assessor was moderate and poor before and after analgesia, respectively (Fleiss Kappa: 0.49, 0). Each horse acted as its own control (repeated measures design); the only variable was removal of pain. Reduction in behaviour scores after resolution of musculoskeletal pain indicates that these behavioural markers are a likely reflection of pain. Although the untrained assessors did identify a significant reduction in behavioural markers in non-lame horses, the study highlighted that some training in marker recognition and interpretation would be beneficial. It was not possible to hide the presence of lameness which could have biased the assessors. These behaviours may be easier to recognise than low-grade lameness, facilitating identification of musculoskeletal pain. Research is on-going.

Lay person message: Identification of low-grade lameness is challenging. Lameness as a cause of poor ridden performance is often overlooked. Ears back, mouth opening, unwillingness, crookedness and resistances are often interpreted as behaviour typical of the horse, rather than questioning the cause. We have demonstrated differences in the occurrence of specific behaviours between non-lame and lame horses and in lame horses before and after resolution of pain. Recognition of these behaviours may facilitate identification of underlying pain.

Key words: lameness; behaviour; pain; nerve blocks.

Difficulty of equine temperament assessment in equine assisted activities and therapies

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Temperament is an important factor when selecting horses for equine assisted activities and therapies (EAAT). Interactions between the horse and environment are influenced by temperament and present potential risk of injury, determine the effectiveness of the programming offered, and contribute to high horse attrition rates in EAAT. Temperament assessment of horses entering EAAT is not standardized and often relies on subjective measures performed by staff. The objective of this study was to investigate agreement among raters completing subjective temperament questionnaires and correlations between subjective ratings and objective measures of temperament. We hypothesized subjective measures would have high levels of agreement between raters and would be correlated with objective measures. Standardized behavioural temperament tests (forced known and unknown human approach, spontaneous known and unknown human approach, tactile stimulation (von Frey filament), and sudden novel object (umbrella)) were conducted by trained experimenters and video recorded for analysis with 4 mature horses (1 gelding, 3 mares) prior to placement at an EAAT center. Staff (n=14, mean=23 yrs. of horse experience) completed a 19-question (self-reliance, friendliness towards horses, competitiveness, nervousness, concentration, excitability, curiosity, panic, inconsistent emotionality, vigilance, perseverance, skittishness, timidity, trainability, friendliness towards people, memory, cooperation, stubbornness, docility) instrument developed by Momozawa et al. and an in-house 6-question (nervousness, reactivity, fight/flight, friendliness to people, touch, pressure) instrument. Inter-rater agreement within horse and questionnaire was assessed using Kendall's tau-b rank correlation coefficient (SAS). Raters were considered to be in agreement when $\tau b \geq 0.52$ and $P<0.05$. Correlations between subjective and objective measures of temperament were assessed using Spearman's rank correlation coefficients (SAS). Inter-rater agreement within horse and questionnaire ranged from 0 – 100% with a mean of 34%. Horses assigned poorer memory ratings required more time (46.03±56.47 sec, mean±S.D.) for the human to approach during the forced known human approach test ($\rho=1.00$, $P<0.0001$). Horses rated as having poorer trainability and less stubborn spent more time (209.05±50.47 sec; 107.48±63.61 sec) further than 6 meters from the human in the spontaneous unknown and known human approach tests respectively ($\rho=1.00$, $P<0.0001$). No other significant correlations were found. A lack of agreement between raters and little correlation between subjective and objective measures of temperament indicates limited accuracy of center staff in assessing temperament subjectively. Further work is needed to develop objective measures of temperament that are easily implemented by the EAAT industry.

Lay person message: Accurate and reliable assessment of equine temperament is critical in selecting horses with appropriate temperament for EAAT to reduce risk of participant injury and minimize equine behavioural issues. Temperament questionnaires completed by EAAT staff and volunteers were used to assess agreement among raters and compared to objective measures of equine temperament. Poor agreement between raters at EAAT centres was observed indicating subjective assessment is influenced by rater perception. Additionally, temperament assessed subjectively in the questionnaires had limited alignment with temperament in the objective tests. Lack of adequate measures of temperament may lead to selection of horses not suitable for EAAT.

Keywords: temperament; EAAT; questionnaire; behaviour; selection.

Parameters for the analysis of social bonds in horses

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Social bond analysis is of major importance for the evaluation of social relationships in group housed horses. However, in equine behaviour literature, studies on social bond analysis are inconsistent. The studies show substantial variation in the research design and the interpretation of measurements. Mutual grooming (horses standing side by side and gently nipping, nuzzling, or rubbing each other) is used most often to evaluate social bonds, but as it occurs comparatively infrequently in horses, measurements of spatial proximity (horses standing with body contact or within two horse-lengths) are also commonly used. In the present study we ask whether combinations of directed mutual grooming behaviour with measurements of undirected spatial proximity are sufficient and beneficial. Whether other directed, social behaviours such as affiliative, friendly approaches (horses approaching each other and staying within one body length) may be more suitable for adding to social bond analysis in horses, and whether the animals' frequencies of grooming, friendly approaches and close proximity with group members were affected by environmental and individual factors. We observed social behaviour and spatial proximity in 146 feral horses, five groups of Przewalski's horses (N=37, group size: median=8, min.=5, max.=9) and six groups of feral horses (N=109, group size: median=19, min.=10, max.=26). Continuous observations for social behaviour and 10min scan samples for spatial distribution were conducted for 15h per group, on 3 days within one week. General Linear Mixed Models were calculated for the fixed effects mutual grooming, friendly approaches and spatial proximity and the random effects animals ID, sex, rank, aggressive behaviour, groups, group compositions, and group sizes. We found that grooming, friendly approach, and the spatial proximity appeared to be robust parameters, as their correlation was affected only by the animals' sex (GLMM: N=146, Std.E.=0.001, t=-2.7, P=0.008) and the group sizes (GLMM: N=146, Std.E.<0.001, t=4.255, P<0.001). Our results show a strong correspondence between the frequency and pairwise exchange of mutual grooming and friendly approaches (GLMM: N=146, Std.E.=0.021, t=3.922, P<0.001), a weak correspondence between the animals' pairwise involvement in mutual grooming and spatial proximity (GLMM: N=146, Std.E.=0.04, t=1.15, P=0.25), and a trend for a correspondence between all three counts, mutual grooming, friendly approaches and spatial proximity (GLMM: N=146, Std.E.=0.004, t=1.95, P=0.053). We therefore consider a combination of proactive behaviour counts to be easily realizable and reliable, and suggest adding counts of directed, friendly approaches to counts of mutual grooming for the analysis of social bonds in horses.

Lay person message: As more and more horses are being kept in group housing, it may be crucial for the horses' likes and dislikes of other group members (their social bonds) to be considered. Options for the analysis of social bonds need to be improved. They are commonly evaluated by counting the frequency of mutual grooming between pairs of horses. However, in horses, grooming behaviour is comparatively rare. We found that adding counts of friendly approaches to counts of mutual grooming between pairs of horses combine to make reliable measurements for the analysis of social bonds in horses.

Keywords: feral horses; mutual grooming; social bonds; social bond analysis; spatial proximity.

Significance of group composition for the social welfare of pastured horses

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Data on frequencies of both affiliative (allogrooming, play) and agonistic (aggressive, submissive) behaviours of Icelandic horses kept in spacious pastures, were analysed (glm) with respect to sex, age class, number of friends, and relative rank. Data from 424 individuals (≥ 1 yr old) kept in 20 groups was analysed. Also, non-parametric tests (Spearman rho, Wilcoxon, K-W test) were applied to look for relations between median values of the same behaviours and variables which defined the characteristics of the groups. The variables tested were: presence /absence of stallions, stability, sex ratio (males/females), proportions of adult horses (≥ 4 years), density in pasture, size of pasture, group size, number of newborn foals, season, provision of hey (+/-) and linearity. Six groups were breeding groups (mares, newborn foals, one stallion), three groups included only sub-adults, two groups only adult horses while the rest was mixed (geldings, mares, sub adults). At the individual level aggression and submission was positively correlated with relative rank*** and age*** and sex*** [1] Allgrooming was positively correlated with number of friends *** and negatively with age*. Play[2] was significantly***related to both sex (more in males) and age (more among the young). The group analysis showed that presence of stallions had a major effect*** since the horses were much less aggressive and submissive in the breeding groups. In the other groups increased stability* means less aggression and submission. In groups with higher sex ratios* and higher linearity** the agonistic behaviours were higher. Adults were more aggressive in winters*. Submission was higher in groups with high proportion of adults*. Allogrooming is less in groups with relatively many adults** and where linearity of the hierarchy is low*. Play is more frequent in mixed groups with relatively many sub adults*. For adults in the mixed groups, play is positively correlated with the sex ratio*. The finding that less agonistic behaviour is seen in the breeding groups, in the more stable groups and in groups of lower sex ratios is very interesting. The results are understandable when interpreted in the light of the social system of wild and feral horses and can deepen our understanding of the factors influencing the types and intensity of social interactions in groups of different composition. Their relevance for horse group management and welfare is clear.

[1] *P<0.05, ** P<0.01, *** P<0.001 [2]Play was not measured in the six breeding groups.

Lay person message: To minimize aggression it is important to plan which horses are to be kept together. Because of their social nature horses need to have plenty of opportunities to interact with others to find their place in the hierarchy, establish bonds and learn from their elders. Comparison of social behaviour of horses in 20 groups of Icelandic horses in pastures showed that aggression is lower in groups with relatively many females and few males, but highest in groups which are composed of young horses only. In groups with a stallion aggression is very low. Stability is also of importance, it lowers aggression.

Keywords: aggression; stability; allogrooming; play; welfare.

Behaviour or performance changes: is the primary cause physical, psychological, or both

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A common and often considerable challenge when evaluating undesirable or abnormal behaviour is to sort out physical from psychological primary and secondary causes. Almost any physical discomfort can result in behaviour changes that are easily misinterpreted as primarily psychological (social, learned, or "normal" adaptation to suboptimal environmental conditions). Common example complaints include a negative change in attitude toward work or a general drop in athletic performance without easily recognized signs of injury or disease, a variety of types of episodes of hyper-reactivity, spookiness, or apparent panic with bolting or "freezing," and any of a variety of specific undesirable behaviours such as kicking, stomping, pawing, biting, tail-wringing or slapping, teeth-grinding, head-tossing, or self-mutilation at work and/or at rest without a readily apparent source of physical discomfort. Having evolved as an open plains grazing prey species, horses can be considered relatively "hard-wired" to be slow to show discomfort, especially in threatening situations. It is not that they are not uncomfortable, it is that their behavioural response to discomfort has evolved to be relatively inconspicuous to other species until fairly severe or incapacitating. When observing horses on video obtained when they are alone and "at ease" to let down their guard, you can often appreciate how uncomfortable they appear, and as soon as people approach, they no longer show their discomfort. The sad reality for domestically managed horses is that this natural muted behavioural expression of discomfort and the instantaneous "improvement response" often delay our appreciation of their discomfort. It is not unusual in these situations to interpret behaviour changes as misbehaviour or poor temperament. For the same reasons, humans tend to anthropomorphically misinterpret fear- or stress-based or behaviour. Similarly a horse's confusion resulting from poor understanding or application of learning principles is often misinterpreted as poor learning ability or intentional misbehavior or "stubbornness." Solid academic animal behaviour information (now somewhat available electronically) on principles of species variation as well as species-specific subtle behaviours indicating comfort and discomfort can be helpful to horse owners, trainers and health care professionals when evaluating behaviour changes. Whether or not the causes can be determined and whether or not the primary cause is physical or psychological, behaviour problems without a conspicuous physical cause provide an excellent opportunity for the veterinarian to recommend detailed monitoring of the behaviour with the professional assistance of an equine behaviour specialist. Detailed review of videotaped samples of the horse undisturbed in its stall or paddock ("stall video") can be an efficient and relatively inexpensive aid to identification and localization of physical discomfort. Evaluation by a trained equine applied animal behaviour specialist can often provide valuable insight into primary or secondary psychological causes of particular behaviour changes, as well as recommend effective and humane behaviour modification strategies. Our behaviour service's method of evaluating stall videos has changed little since first detailed in 2005 (McDonnell SM, Is it physical, psychological, or both? 2005 *AAEP Proceedings 51:* 231-23. full manuscript available at *http://www.vet.upenn.edu/docs/default-source/research/equine-behaviorlaboratory/aaep05smm.pdf?-sfvrsn=5c26e0ba0*). Norms for stall time budgets are detailed in that publication along with examples of clusters of behaviour consistent with various diagnoses. Technicians can be trained quite readily to recognize clusters of behaviour consistent with, for example, lameness, back and neck discomfort, gastric ulcers, caudal gastrointestinal discomfort and other

caudal abdominal visceral discomfort, urinary system discomfort, pelvic skeletal discomfort, head and mouth discomfort, cardiacrelated syncope, neurologic conditions including mild seizures and related behaviours.

Lay person message: Behaviour and performance changes can result from many different physical or psychological reasons. Likely one of the top threats to welfare of horses these days is failure to recognize physical discomfort as the root cause of behaviour changes. Far too often the primary cause is physical discomfort that is often not easy to identify without careful methodical (and expensive) veterinary diagnostics. When it is assumed to be a training or personality issue, horses are often forced to suffer through any variety of regimens, for example vigorous training, supplements, specialized behaviour modification, that not only do not address the root cause, but may actually exacerbate the physical disease or injury. Detailed review of videotaped samples of the horse undisturbed in its stall or paddock ("stall video") can be an efficient and relatively inexpensive aid in recognizing and often localizing physical discomfort. A trained equine behaviour specialist can provide insight in whether a particular behaviour or performance change is primarily due to physical discomfort.

Keywords: equine behaviour problems, equine pain, physical causes, behavioural causes.

"It is necessary that the horse heading to the fence learns not to fear the rider's actions and gets convinced that he/she allow it to jump and does not impede it nor causes it pain in any way. Conversely, the horse instead of being careful in its task, will study the way to avoid pain. For this reason, the horse has to get used to trust its rider and not fear his/her actions..."

(Carlo Giubbilei "Federico Caprilli, Life and Writings", p. 93)

Equine recumbent sleep deprivation: effects on mental and physical health

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Sleep is a reversible behavioural state which is common in all species. Though there is still little known about the complex function of sleep, it is vital as prolonged sleep deprivation leads to physical impairment, cognitive loss and eventually death. Rapid eye movement (REM)-sleep, necessary for full sleep cycles requires complete muscle relaxation and therefore only occurs in recumbent positions. Horses suffering from recumbent sleep deprivation and the associated REM-sleep deficiency experience atonic collapses. The aim of this study was to examine affected horses, to create sleep profiles and to evaluate husbandry conditions. A call to owners of horses with collapses was made and a questionnaire was completed by 177 owners. Management, stabling conditions and medical histories of 36 horses were documented. They were studied via clinical exams, observations and polysomnographic measurements. Polysomnography is a multiparametric test to determine sleep stages. Seven horses without collapses served as a control. The questionnaire showed a significant correlation between a change in the husbandry and the first collapses (P<0.001). 90.2% (95% Confidence Interval (CI95) 86.2-94.3) of the horses showed injuries after the collapses. Injuries were mostly seen at the carpi (72.4%; CI9565.5-79.3) and the fetlocks (68.4%; CI9560.9- 75.3). Furthermore, 31.0% (CI9524.1-38.5) of the horses showed head injuries and 18.4% (CI9512.7-24.7) injuries at the hock. Stereotypic behaviours (weaving, cribbing) was observed in 24.9% (44/177). The examined horses experienced 64.0±40.5 collapses per day, the individual number depending significantly on the lying behaviour. Animals lying down to sleep showed fewer collapses (P<0.05; Cohen's effect size d=3.0). Horses with collapses spent notably less time in REM-sleep compared to horses without collapses (P<0.005; Cohen's d effect size=1.4). Their REM-sleep phases were shorter (P<0.001; Cohen's d effect size=5.2), occurred while standing and were mostly in temporal context with collapses (86.7%). In 33.3% (12/36) the areas provided for lying down were too small in size, in 50.0% (18/36) there was an obvious relation between an event (change of stable, illness) and the onset of the collapses. Eight horses showed an altered behaviour (hysterical, somnolent) ever since. Two years after the evaluations 7 horses were euthanized due to injuries or behavioural problems supposedly caused by the collapses/ sleep deprivation. Given the importance of sleep, REM-sleep deprivation leads to behavioural changes and collapses can cause severe injuries. Therapy should comprise identifying the reason of the reluctance to lay down, treating causative medical conditions, reversing the environmental changes and improving the husbandry.

Lay person message: Sleep is essential for a horse's health and well-being. Rapid eye movement (REM)- sleep is part of a complete sleep cycle. It occurs only while the horse is lying due to its associated complete muscle relaxation. When horses don't lie down, REM-sleep deficiency occurs. They fall into REM-sleep while standing which causes collapses due to the muscle relaxation. These collapses cause severe injuries and the lack of sleep causes behavioural problems.

Keywords: sleep; polysomnography; recumbent sleep deprivation; REM-sleep deficiency; welfare.

Injury incidence and locomotor patterns in polocrosse ponies

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There is currently limited information available regarding the physical demands of polocrosse and no information on the specific veterinary problems faced by polocrosse ponies in the United Kingdom. Polocrosse requires the ponies that compete to perform rapid acceleration, sharp turns and sudden halts. It is important that the physical demands placed upon polocrosse ponies are investigated. This will allow identification of injury risk factors, inform improved training programmes and improve the performance and welfare of the horses involved. The aim of this study was to record the injuries sustained by polocrosse ponies during outdoor tournaments in the UK over the 2015 and 2016 seasons. In addition, GPS data and locomotor patterns were recorded from 14 ponies (4 defence, 4 attack and 6 centre) during winter league tournaments and compared between the different position ponies. In total 116 horses were removed from tournaments by the attending vet due to injury during the time period studied. A Chi-Square test revealed that ponies that played in the defence position were significantly more likely to become injured ($p<0.001$) with lameness being the most common injury ($p<0.001$). Ponies playing in attack position achieved the fastest speeds and covered the furthest distance. A one-way ANOVA revealed that defence ponies performed significantly more abrupt halts ($p=0.007$), walk to gallop transitions ($p=0.017$) and sudden changes in direction ($p=0.01$) than centre position ponies and more of each manoeuvre than attack position ponies although this was not significant. The findings of this study can be used to inform future work investigating the demands placed on polocrosse ponies allowing appropriate training programmes to be developed.

Lay person message: This study investigated the physical demands placed upon polocrosse ponies. Differences were found in speed, distance travelled and movement patterns between the three positions played by ponies (attack, centre and defence). Results will help to inform improved training programmes specific to position, with the aim of reducing injury risk and improving overall welfare.

Keywords: Polocrosse; welfare, injury, training.

Pain or not pain? A statistical approach to identify a pain classifier based on HGS

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Pain recognition is a fundamental step for safeguarding horse welfare. The Horse Grimace Scale (HGS), a facial-expression-based pain coding system, proved to be valid in identifying a range of acute pain conditions in horses. Here we propose a statistical approach to identify a classifier, based on Facial Action Units (FAUs) of HGS, capable of determining if a horse is in pain or not by effectively separating horses into pain or no pain categories. Surgical castration is a good model for studying pain because it is a routinely carried out and standardized procedure, where we can assume that horses before the surgery are not in pain, while after surgery the same horses will be in pain. The dataset consisted of a total of 294 images (No Pain = 164 images; Pain = 130 images); HGS scores were attributed by five trained but treatment- and condition- blind observers. A statistical approach was applied to the existing dataset: Inter Class Correlation Coefficient (ICC) was used to test inter-observer reliability; a regression model for ordinal data, the Cumulative Link Mixed Model (CLMM), was used to assess how the pain condition of the horses (fixed effect), the observers and the subjects (random effects) influence the score of each FAU; Multiple Correspondence Analysis (MCA), the counterpart of principal component analysis for categorical variables, was used to evaluate the associations between the score of the FAUs; Linear Discriminant Analysis (LDA) was used to classify the pictures in two groups according to the pain condition ("Pain" vs "No_Pain"), based on the scores given by the observers. Reliability among observer was good with ICC=>0.61. Individual FAU scores were related to the pain state of the horse (CLMM; $P<0.001$). The MCA of the FAUs scores identified that the first component explained 90.73% of variation, with categories related to higher level of pain (score 2) on the opposite side to categories related to absence of pain (score 0). The LDA identified the optimal weights of the FAU scores that were used to develop a classifier for discriminating the "Pain" group from the "No Pain" group. This classifier achieved a 77.4% of accuracy, in identifying the correct pain status of each horse picture from the corresponding scores. Among the 294 scores analysed, LDA correctly classified 139 scores related to the "No Pain" group and 91 related to the "Pain" group, while 25 were wrongly assigned to the "No Pain" group and 39 to the "Pain" group. Scores for stiffly backwards ears, orbital tightening, tension above the eye area, and prominent strained chewing muscles contributed to the classification of the horses in the correct pain status. To date, the HGS has only been used as a research tool; our results suggest that it is possible to define a classifier and cut off values, thus advancing its applicability to clinical scenarios. The classifier proposed is the starting point to develop a computer-based image analysis for the automatic recognition of pain in horses.

Lay person message: Pain recognition is paramount for safeguarding horse welfare. To progress the validation of the Horse Grimace Scale (HGS), a facial-expression-based pain coding system, we proposed a statistical procedure (technically called "classifier") for identifying the pain condition of horses from the HGS scores. Our results suggest that it is possible to define a pain classifier based on HGS score, thus advancing its real-world applicability, e.g. to veterinary care. This can be the starting point to develop a computer-based image analysis for automatizing horse pain recognition.

Keywords: pain; HGS; Horse Grimace Scale; classifier.

No 'animal' is an island: understanding emotional connection at the basis of social life

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Humans live completely nestled in an emotional network that makes us socially inter-dependent beings. But in this "emotional sphere" we are not alone. Animals experience and express emotions, too. This is now a matter of fact, not a speculation anymore. One of the most fertile fields of research is the facial and bodily motor expression of emotions, including how human and non-human animals are able to perceive others' emotions by decoding and, in some cases, mimicking the motor pattern making such emotion manifest. The same face–same emotion mechanism is an extremely adaptive phenomenon that is based on the perception-action coupling mechanism mediated by the mirror neuron system and it is a clear indicator that the facial and bodily motor expressions have been properly perceived and decoded. The ability to perceive others' emotions has an important role in regulating dyadic relations and favours the formation of strong, enduring social bonds, which in turn enhance reproductive success. Recent and consistent findings strongly demonstrate that this ability is not unique to humans. In the last decades, many researchers have become increasingly aware that the only possibility to understand even the most complex forms of emotional contagion (a basic form of empathy) was to move the magnifier from humans to other animals, especially those which share with humans a strict evolutionary history (primates) and those which share with us affective relationships (domestic species). In this talk, I will review and present original observational and experimental data showing how, in wild and domestic species, decoding and mimicking facial and bodily motor patterns are at the bases of social interactions and reliable predictors of emotional closeness. Then, I will focus on horses to take stock of the lively debate about emotions in these complex animals. Horses seem to be good candidates to explore the issue for many different reasons. The perception of different kinds of emotions (positive or negative) affects the cognitive flexibility of this species. Horses are able to integrate different sensory systems (cross-modally) to individually recognize not only conspecifics but also humans. The perception of human facial features extends to the perception and ability to discriminate between positive (happy) and negative (angry) human facial expressions. Horses remember humans' emotional expressions that they have seen in the past and these memories for emotion are specifically attributed to the human subject whose face they saw. Moreover, the capacity to distinguish faces and perceive emotions on those faces appears to be influenced by the social relationships linking the horse with its care-taker. As it occurs in many other social mammals, familiar, more than unfamiliar subjects, are able to elicit higher attentional bias and more accurate responses in horses. In conclusion, due to the extreme complexity of the topic, if we want to deeply understand the proximate and the ultimate factors of emotional expression and sharing in animals we should apply a cross-species research (different species in both intra- and inter-specific contexts). Moreover, the study of emotions requires a multidisciplinary approach because a large number of internal and external factors concur in triggering and modulating the emotional outcome to social and environmental stimuli. This challenge can be won only if ethologists, psychologists, neurobiologists and physiologists join their forces and motivations and try to explore the issue from different point of views.

Lay person message: In 1872, Darwin grasped that the expressions of emotions in human and non-human animals are extremely similar and underlined the evolutionary continuity of the behavioural traits unveiling emotions such as body postures, facial expres-

sions and vocalizations. Nowadays, it is quite clear what 'the master' had in mind. Indeed, the research focused on animal emotions is providing quantitative evidence that animals are more complex from an emotional perspective than previously thought. I think that one of the most fascinating challenges is to understand if such emotions can be shared not only between animals of the same species but also between animals belonging to different species, even though I suspect that Darwin had already it in mind...'*But man himself cannot express love and humility by external signs, so plainly as does a dog, when with drooping ears, hanging lips, flexuous body, and wagging tail, he meets his beloved master. Nor can these movements in the dog be explained by acts of volition or necessary instincts, any more than the beaming eyes and smiling cheeks of a man when he meets an old friend.*'

Keywords: social mammals; emotional decoding; facial and bodily motor expressions; social bonding; comparative research; Multi-disciplinary approach.

> *"...because the hands of the riders wanting to obtain some changes in the head and neck position, cause an unpleasant sensation on the mouth itself that turns into a hardening of a part of this, in extra-bending the neck, in the habit of bringing their head up in the air, in beating the hand, in hurting the bars, in making the lips thickened or the mouths hardened, for which horses often run away."*
>
> (Carlo Giubbilei "Federico Caprilli, Life and writings", p. 248)

Horse communication: what does non–nutritive chewing mean?

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In some traditions of horse training, non-nutritive chewing is assumed to be a signal that the horse looks at the human as the leader or "boss". One example is the 'join up' training method, whereby the trainer drives a wild horse until it stops fleeing and starts chewing, which is interpreted as submissive behaviour. To gain insights into the function of non-nutritive chewing behaviour under natural conditions, we observed contexts in which wild horses perform non-nutritive chewing movements during social interactions. We investigated the hypotheses that horses perform non-nutritive chewing: (1) during relaxation after a tense encounter and (2) to signal submission to another horse. To examine the first hypothesis, we observed the frequency of relaxed and tense behaviours before and after non-nutritive chewing, with the prediction that horses are less tense and more relaxed after than before chewing. The prediction for the second hypothesis was that, when one horse approaches another horse in a threatening manner, the recipient but not the approaching horse would perform non-nutritive chewing behaviour. Data were collected during 80 hours of observation on feral horse herds in Ecuador, in which 202 sequences of behaviour before and after non-nutritive chewing were documented. In support of the first prediction, counts of tense behaviour were 128 before and 16 after chewing whereas counts of relaxed behaviour were 74 before and 186 after chewing (Chi-squared=149.0, df=1, $P< 0.001$). Contrary to the second prediction, chewing was performed by both approaching and recipient horses. The results suggest that non-nutritive chewing was not used as a submissive signal by horses in the contexts observed but, rather, that it was associated with arousal reduction. Chewing could be associated with a switch from a dry mouth induced by sympathetic arousal to salivation associated with parasympathetic activity. This finding is consistent with the interpretation that non-nutritive chewing is related to stress-coping, raising a caution against training methods that use chewing as an indicator of whether horses accept humans as their 'boss'.

Lay person message: Observations on feral horses in Ecuador showed that non-nutritive chewing was associated with relaxation following tense behaviour. However, chewing was performed at similar rates when threatening another horse as when being threatened. These findings suggest that non-nutritive chewing during social interactions is associated with stress reduction rather than signaling submission. Therefore, chewing during training may be a sign of stressful training methods rather than indicating a horse's acceptance of the trainer.

Keywords: feral horses; natural behaviour; non-nutritive chewing; social interactions; signals.

Spontaneous blink rate as a measure of equine stress

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In humans, Spontaneous Blink Rate (SBR) has been used as a non-invasive measure of neural function. The instantaneous flight response in horses can be dangerous to handlers and thus it is important to quickly and objectively measure stress levels in the horse. Monitoring SBR may be a useful measure in this respect and, as an inferred measure of stress or anxiety, SBR may also be advantageous in the quantification of equine welfare. This study observed 33 horses (mean age 11±6 years; 21 geldings, 12 mares) during a 10-minute sham clipping procedure designed to initiate a moderate stress response. SBR (measured at blinks per minute) was videoed and the data were compared with Heart Rate Variability (HRV) frequency domain analysis (ratio of low to high frequency bands in HRV) and time domain analysis (Root Mean Square of the Successive Differences of the beat to beat interval, recorded in milliseconds) of HRV data sampled for 10 minutes using a Polar® Equine V800 Science heartrate monitor. Results were analysed using Kubios® software, using a low threshold for artifact correction. Salivary cortisol was also measured using Salivette® cortisol swabs and analysed using Salimetrics cortisol ELISAs. By sampling each parameter for 10 minutes 'before' and 10 minutes 'during' the sham clipping procedure, each horse acted as its own control. A significant physiological stress response was observed in 16 horses (increase in mean salivary cortisol concentration 1.5±0.9 versus 2.7±1.5 nmol/l, df=31, $P<0.001$). In these horses, there was a highly significant increase in the mean SBR (9.0±3.9 versus 14.1±7.0 blinks/min, df=328, $P<0.001$) over the duration of the clipping. For the entire sample, there was also a significant decrease in SBR (9.9±3.6 versus 8.3±5.6 blinks/min; df=361, $P<0.05$) over the first minute of clipping, regardless of overall stress response. Two sample t-tests assuming equal variance were used in each analysis. The results of this study suggest that SBR may be a very sensitive measure of neural function and the interplay of sympathetic and parasympathetic nervous systems associated with the stress response. The initial reduction in SBR in the first minute of a stressful event may demonstrate a 'startle' response with the horse visually fixed on the novel stimulus to gain the maximum amount of visual information before responding. Due to the rapid change in emotional state in horses, SBR may be a more sensitive metric than either time domain or frequency domain analysis of HRV.

Lay person message: In humans, Spontaneous Blink Rate (SBR) has been used as a non-invasive measure of stress. This study assessed the use of SBR to measure stress in horses. The SBR of 33 horses was measured during a clipping procedure (low-moderate stress) and compared with other recognised measures of stress. It was found that if the horses became anxious, the SBR dramatically increased, but only for the duration of the stressful event. Monitoring SBR may be potentially useful for 1) handling horses in stressful situations and 2) quickly and objectively measuring equine stress levels in a real-time, non-invasive and costeffective way.

Keywords: stress; blink rate; cortisol; HRV; welfare.

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Evidence that right sided horses are more optimistic than left sided horses

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The absence of stress indicated by physiological and behavioural stress parameters does not necessarily imply a healthy mental state in horses. Therefore, the individual's perspective when judging a neutral stimulus as positive or negative (cognitive bias, CB) can help when assessing animal welfare, e.g. enrichment of housing conditions can induce a positive CB. Emotionality, or approach versus withdrawal behaviour, is linked to brain asymmetry. The predisposition to process information in the left or right brain hemisphere is displayed in motor laterality (preference to use the left or right forelimb). The quality of processed information is indicated by the sensory laterality (preference for left or right sensory organs). Consequently, it would be more efficient to assess motor or sensory laterality to gain insight into CB. Therefore, we tested whether CB is related to motor laterality. The horses (n=17) were trained to discriminate between two locations (left and right) of a box. One location was "positive" (closed box which the horse could open to reach a food reward), and the other was "negative" (locked box with food reward). The positive location was either on the left (n=8) or right (n=9). The horses were released on a start line and were free to go to the box. After all horses successfully discriminated between the positive and negative locations (latency to reach positive box was significantly shorter, Wilcoxon test, n=9, $P<0.05$ for all horses) the box was placed in the middle, a neutral location. The latency to reach the box within 60s was measured. Results indicated that horses that were more likely to use the right forelimb when moving off from a standing position reached the neutral box with a shorter latency (generalized linear model (GLM) with random effects: $t=-3.7$, $P<0.01$). However, there was no significant relation between the latency to reach the neutral box and the forelimb placed in front while eating from the box in training sessions (GLM with random effects: $t=-0.8$, $P=0.42$) or during hay eating/grazing (GLM with random effects: $t=0.4$, $P=0.71$). There was no significant overall relation to sensory laterality (GLM with random effects: $t=1.0$, $P=0.34$). To summarize, horses that are more likely to use the right forelimb when moving off from a standing position display a more positive CB (optimistic). Horses that are more likely to use the left forelimb to move off from a standing position display a more negative CB (pessimistic).

Lay person message: The study demonstrates that horses that use the right forelimb when starting to move off from a standing position are more likely to expect a neutral stimulus to be positive, and to be in an optimistic mental state, than horses that use the left forelimb when starting to move off from a standing position.

Keywords: cognitive bias; motor laterality; sensory laterality; optimistic; pessimistic; judgment task.

Physiological effects of stress–releasing behaviours in horses: the resilience theory

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To cope with a stressful stimulus, animals can react both behaviourally and physiologically to restore the homeostasis disrupted by the stimulus itself. In stabled horses, a stressful stimulus can be represented by social separation, riding discomfort or the presence of novel objects in their environment. Although in this species Heart Rate Variability (HRV) is an accepted indicator to evaluate stress levels, little is known about the link between endogenous reactions and behavioural mechanisms, which concurrently occur under a stressful condition. The sudden inflation of a balloon was administered to 33 horses (mixed-breed, aged 6- 24 from four different stables in Italy) in their familiar environment. A video-recording of self-directed behaviours (snort, vacuum chewing, sneezing snort and head/body shaking) and a monitoring of heart activity (Heart Rate, HR, and HRV) of the animal was carried out in continuum for five minutes before (Pretest) and after the stimulus administration (Stress-test). The tests were stopped if any significant stress responses were observed. During the Stress-test, only snort and vacuum chewing increased (Exact Wilcoxon's Signed Rank Test, n=33, Tsnort=42.50, P=0.0001; Tvacuumchewing=27.00, P=0.017). Regarding heart activity, a significant increase was recorded in both HR and Standard Deviation of R-R peak intervals (SDRR) (Paired Samples t Test, n=33, t=-2.613 PHR=0.014; t=-4.470, PSDRR=0.0001). Since the reduction in SDRR indicates a transition toward sympathetic control over cardiac activity, an overall decrease of SDRR should have been expected during the Stress-test. Moreover, the snort variation between the two conditions showed a significant correlation with the variation of both HR and SDRR (Spearman Correlation, n=33, r=0.545, PΔSNΔHR=0.001; r=0.524, PΔSNΔSDRR=0.002). If we consider snort as a stress-releasing behaviour mainly expressed in the first two minutes of the Stress-Test to restore a basal condition, the variation of SDRR values across the 5-min window is not surprising. The homeostasis obtained via the enactment of such behaviour could be physiologically expressed in a proper sympatho-vagal balance, corresponding to the increasing SDRR values. Hence, the capacity to maintain homeostasis (resilience) explicates how the deviation from specific physiological values may be counteracted by physiological and behavioural responses, whose only purpose is to restore the basal level.

Lay message: Recognizing specific stress-related behaviours in horses is crucial for riders and caretakers to properly interpret the internal state of animals and to improve their welfare. Nevertheless, little is still known about these behaviours. The snort in particular was found to be a good indicator of a stressful condition, acting as a stress-releasing behaviour to restore the homeostasis. The enactment of specific behaviours after a stressful stimulus represents the physiological expression of a disrupted balance; this ability is extremely adaptive and is known as resilience.

Keywords: *Equus caballus*; heart rate variability; homeostasis; calming behaviours; snort; vacuum chewing.

Social learning in horses? The importance of seeking the simplest explanation

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As group-living animals, horses are often assumed capable of acquiring new behaviour through social learning. Solid evidence of true social learning in horses is however lacking. Research on the topic includes a variety of studies, some of which may over-estimate the mental abilities of horses. Assuming such abilities in their absence can have detrimental welfare implications, e.g. when isolating stereotypical horses on the assumption that these behaviours can be learned though observation by neighbouring horses. This review aims to critically assess the basis for arguing that horses possess the ability of acquiring new behaviour through social learning. The behaviour of an animal can be modified in various ways. Individual learning refers to the animal acquiring new behaviour by its own experience whereas social learning is when the animal attains new behaviour after observing a conspecific performing the behaviour. Other processes, such as local and stimulus enhancement, describe situations where the attention of an observer is drawn towards a specific location or class of stimuli, but any subsequent learning is obtained through individual associative learning. In contrast, true social learning describes situations where the observer *copies* the motor patterns of the demonstrator by some process of cross-modal matching which requires a certain level of higher mental abilities. It is important to always seek the simplest explanation to the learning mechanism involved, and in many cases, local enhancement followed by individual associative learning may be the most likely explanation of the results in various studies. Higher mental abilities are energetically costly, and from the viewpoint of the equine foraging ethogram and mammalian metabolic demands, it is clear that social facilitation and local enhancement provide sufficient transfer of information from one horse to another. Nevertheless, some studies suggest that horses are capable of true social learning. This review critically assesses these studies and reveals that proper control groups often are lacking, and that many demonstrations are applied making it questionable to argue that the horse learned from observing another horse rather than from individual associative learning. Thus, while horses are indeed sensitive to social transfer of information, the underlying mechanisms appear to be social facilitation and local enhancement, rather than true social learning. Acknowledging this will not only benefit horse training but also improve horse welfare.

Lay person message: Horses are often assumed to be able to learn new behaviour from watching other horses. However, solid evidence of such learning mechanisms is lacking. Over-estimating the mental abilities of horses has implications e.g. when stereotypic horses are kept isolated because owners fear that neighbours may copy the behaviour, although this theory has never been confirmed. This review highlights that horses may not be able to utilize true social learning but are indeed sensitive to social transmission allowing e.g. naïve horses to habituate to frightening situations in the presence of a calm companion. This information is crucial for horse training and welfare.

Keywords: Horse; cognition; social learning; social facilitation; welfare; training.

PL4

Is my horse/pony obese and why should I be worried if it is?

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Obesity can be defined as the 'excessive accumulation of body fat to the extent where it has a deleterious impact on health'. Although seeing an obese horse/ pony is not new, the number of obese animals, especially within the pleasure/leisure arena, appears to be increasing and it is becoming a globally recognized welfare issue not least because it is associated with an increased risk of laminitis, and some specific forms of colic. In addition, the increased mass and volume of fat serve to limit reproductive and athletic performance as well as placing increased stress on the skeletal system. This review will highlight important aspects of how we can measure, define and monitor equine obesity and why it is important: concentrating on the link between diet, obesity, and laminitis. With respect to defining obesity, recent work has led to deuterium oxide dilution becoming the gold standard method to determine % body fat and resulted in horses and ponies with a body condition score of ≥7/9 being considered obese. The best way to manage an obese horse or pony is to prevent it from becoming obese in the first instance and for any weight loss programme to have a chance to work the owner/ feeder needs to recognise that the animal is overweight and that it needs to lose weight. Unfortunately many people find it difficult to correctly identify overweight animals by their visual appearance alone and other more practical methods of measuring and monitoring are being explored. As part of understanding why animals become obese it has been shown than ponies can ingest around 40% of their daily dry matter intake and up to 1% of their bodyweight in dry matter within a 3-hr turnout period plus nearly 5% of their body weight in dry matter/24hrs intake. This has led to many studies looking at protocols to manage weight loss and prevent weight gain, including investigating the use of grazing muzzles, and other means of reducing forage intake whilst optimally extending the intake time. Whilst obesity is not always associated with the development of tissue insulin resistance and can even result in an increase in insulin sensitivity, many obese animals will demonstrate insulin dysregulation when ingesting a starch or sugar rich feed. Insulin deregulating animals have an increased risk of laminitis and therefore management practices that result in reduced insulin response to the ration may help reduce the risk of laminitis.

Lay person message: It can be very difficult to promote weight loss, especially in certain individual horses/ponies once they become obese. Therefore, it is very important for all owners/feeders to firstly appreciate the reasons why ideally their animal should not be allowed to become obese and secondly to be able to recognise when they are starting to put on weight, so that appropriate management and feeding strategies can be put in place as quickly as possible.

Keywords: obesity; welfare; insulin; laminitis; management; monitoring.

The effect of variation in forage type and form on equine mastication and feed consumption in riding school horses

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Current feeding practice aims to increase forage intake to mimic more natural feeding of horses. Increased forage consumption has multiple health benefits including reducing metabolic disorders such as gastric ulceration and colic, prominent issues within the industry. Understanding how different forages affect intake and eating patterns is thus important to future diet design. A sample of mixed breed horses (*n*=9) from a college herd were fed four forage types at 1 kg each (Grass Chaff; Chopped Sainfoin; Lucerne Chaff; and Extruded Forage Piece), plus a combination (Grass Chaff and Extruded Forage Piece, 50:50) in a Latin square design, each for five minutes. During this time, surface Electromyography (sEMG) was used to measure the activity (Amplitude mean, Hz) of five facial muscles (Long Muscle of the Head, Styloho'd, Occiptomandibular, Medial Pterygold and Digastric). Eight skin markers were also placed across the skull and mandible, and video recorded before being analysed using Quintic v29® software to measure masticatory movements of the jaw. Chew and forage consumption rates were also measured throughout. There were significant differences found in sEMG activity (χ^2=27.91, df=1, n=9, P<0.0001) between feeds. No significant difference in the jaw movement was seen between feeds. Significant differences in chew rate (χ^2=29, df=4, n=9, P<0.0001) and consumption rate between forage types (χ^2=11.56, df=1, n=9, P=0.021) were identified. These results indicate that inclusion of long particle forage (Grass Chaff) to a smaller particle forage (Extruded Forage Piece) increased the masticatory effort required during the breakdown process, possibly stimulating increased saliva production and promoting normal dental wear and decreased intake rate. This may be beneficial to reduce the rate of gastrointestinal passage to optimize digestive efficiency. This may therefore optimise gastrointestinal function, whilst mitigating many of the adverse effects associated with the processed feed given widely given to the domestic horse, although more research is warranted to investigate a wider variety of forage types and concentrate combinations to identify chewing biomechanics differences that may improve management.

Lay person message: Changing forage types provided in the horses feed seems to influence feed consumption rate, number of chews per minute and facial muscular effort. However, no significant difference in visual jaw biomechanics was found. This indicates that forage presentation is important, and inclusion of forage can be used to mimic natural feeding to reduce negative effect of the domesticated horse's diet and to overall improve equine health and welfare.

Keywords: nutrition; mastication; electromyography; biomechanics; forage; consumption.

The effect of different approaches to forage provision on stabled horses' behaviour

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Whilst many appreciate the value of providing horses with constant access to forage, discussion continues about how to present forage to horses in a way which best meets their ethological needs, especially within the limitations of a stable environment. This study looked at the effects on horses' behaviour of two approaches to forage provision within the stable. Horses (n=10), with experience of being fed from the floor and from a hay net, were conveniently sampled from the equine population of a college equestrian centre. All horses were exposed to two conditions: a stable with a single feeding station (SS), being the way the horse was normally fed forage (either on the floor or from a large-holed hay net) and a stable with multiple feeding stations (MS: FS1=floor feeding, FS2=small-holed hay net, FS3=large-holed hay net). Each horse was exposed to each condition for one to three days, according to their availability due to their work schedule and were fed their usual type and quantity of forage throughout. The horses were video-recorded over the whole experimental period. Data were collected on eating behaviours (pulling forage, chewing forage and foraging) and non-eating behaviours (drinking, resting and 'other'), head and neck positions (HNPs; low, level and high) and the length of time forage was available. There were no significant differences in the time forage was available, the time taken to finish the forage, the frequency of HNPs or observed behaviours between the feeding conditions, with the exception of pulling forage ($t=2.98$, d.f.=9, $P=0.015$, MS Median=39.50, SS Median=10.49). However, a few significant differences were recorded in the frequency of behaviours when data from the three feeding stations in MS were analysed separately, with a higher frequency of pulling forage at the hay nets than at the floor (FS1 vs FS2: $t=-2.91$, df=9, $P=0.017$; FS1 vs FS3: $t=-3.06$, df=9, $P=0.014$, FS1 Median 6.00, FS2 Median 18.00, FS3 Median 13.00). Chewing was more prevalent at FS1 than either FS2 or FS3 (FS1 vs FS2: $W=49.0$, df=9, $P=0.032$; FS1 vs FS3: $W=53.5$, df=9, $P=0.009$, FS1 Median 5.116, FS2 Median 1.554, FS3 Median 1.107). The provision of multiple feeding stations appears not to significantly increase eating time or foraging behaviour, suggesting that different approaches may be needed to influence these behaviours. Feeding from hay nets appears to increase 'pulling' behaviour, whilst feeding from the floor appears to increase chewing behaviour, however, the welfare implications of these findings are unclear.

Lay person message: The way in which forage is provided to horses may affect their welfare. This study examined the behaviour of horses when fed from one source, compared to multiple sources (hay nets and the floor). There was no difference in the time it took the horses to finish their forage, but horses eating from hay nets showed increased hay 'pulling', whilst eating from the floor resulted in more chewing. The precise welfare implications of these findings are unclear, but they give insight into the effect on behaviour of different ways of providing forage to horses.

Keywords: welfare; forage; behaviour; feeding.

To rug or not to rug: potential impacts on equine welfare

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The thermoneutral zone (TNZ) describes an optimal range of ambient temperatures, within which horses can comfortably maintain a stable core temperature. For mature horses adapted to mild climates, this is between 5°C and 25°C. Within the TNZ, thermoregulation relies primarily on physical responses such as piloerection, vasodilation or vasoconstriction and behavioural adjustments, such as seeking shade or sheltering. Compared to horses, humans have a relatively narrow TNZ of 25°C – 30°C. When humans feel cold, horses are towards the upper limits of their TNZ. This raises concerns when humans make management decisions based on themselves, such as rugging due to personal temperature perceptions. Rugs aid in protecting domestic horses against adverse weather conditions or insects. However, knowledge of their impact on thermoregulation and welfare is limited. The aim of this study was to investigate the impact of rugging on horse surface temperature as a potential indicator of thermoregulation processes and welfare status. Surface temperature was recorded from ten horses whilst wearing their normal rug and two control horses with no rug. Concurrent ambient temperature was also recorded. Temperature was recorded every minute over a twenty-four hour period using temperature data loggers. Data loggers were positioned directly on the horses, just below the tuber coxae, with a further data logger attached to the stable door or wooden mounting block within the field to obtain ambient temperature. Horse surface temperatures and differences between horse temperature and ambient temperature were calculated and compared between rug type. Temperature data were analysed using the Kruskal Wallis test. Differences in temperature data between rug type were then investigated further using a mixed effects model and Bonferroni pairwise comparisons. Significant differences between ambient and horse temperature were recorded in horses wearing different rugs (Kruskal Wallis: X^2=14885.67, df=3, P<0.001). Horses wearing sweet itch rugs showed no significant differences between ambient and horse temperature to horses without rugs (Bonferroni: df=15, P = 1.000). Fleece and light quilted rugs were found to result in a significant increase in surface compared to ambient temperature (Bonferroni: df=15, P<0.001). Four rugged horses had surface temperatures between 24°C - 30°C, compared to control horses of 12.5°C - 18.5°C, when ambient temperature fell below the TNZ to 4°C – 4.5°C. This study indicates that rugging increases horse surface temperature suggesting a significant impact on thermoregulation. Rugging can therefore have detrimental impacts on horse welfare dependent on their appropriate use and application.

Lay person message: Horses are able to effectively regulate their temperature across a much wider temperature range (5-25°C) than humans (25-30°C). Modern management of horses, combined with popular trends, results in regular rugging of horses to protect them from the elements often with limited regard for the potential of overheating. Rugging horses can be effective in reducing temperature loss however, this study suggests that in some instances rugging may result in horses experiencing surface temperatures above their thermal neutral zone, suggesting that thermal regulation may be compromised.

Keywords: horse; temperature; thermoregulation; welfare; rug; blanket.

Shade use by horses in the arid southwest

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In Arizona, where high temperatures (>32 C) are common, there is limited data on horse behaviour and use of shade structures to block solar radiation as temperatures rise. The objective of this study was to examine if increasing Temperature Humidity Index (THI) increased time spent near a shade structure during daylight hours and decreased overall activity of horses. Additionally, we hypothesized that shelter orientation (long side east/west vs north/south) would affect shade usage. During summer of 2017, four paddocks (4800m^2, 4800m^2, 2064m^2, and 3440m^2) with existing rectangular shade structures at the University of Arizona (UA) Equine Centre were utilized to determine equine shade usage (approved by UA Institutional Animal Care and Use Committee). Horses were divided into two groups (group 1: five geldings; group 2: six mares) and fitted with global positioning system (GPS) tracking collars to record the animals' location at 5 second intervals from 5 AM to 8 PM. Each group spent one collection period (two days adaptation, five days data collection) in each paddock. ArcGIS software was used to analyse GPS data. Variations in heat and humidity were normalized by calculating THI for each hour of the collection periods, which ranged from 62.7 to 85.5, and averaged 78.3. Horses were considered to be near the shade within 15m of the centre of the structure. Overall, horses spent little time near the shade (average 17%) during data collection hours, and shade use behaviour was not correlated with hourly THI changes ($r^2(9)=0.0042$). Additionally, THI was not correlated ($r^2(9)=0.0017$) with distance travelled (activity). Geldings spent significantly more time near shade compared to mares (20.3% vs 13.8%, 2-tailed t-test, df=10, P<0.01). There were no differences in daily activity between the two groups. Shade orientation played a role in shade usage. In pastures where the shade was orientated longer side North-to-South, horses were near the shade 18.7% of the time, compared to 14.2% in paddocks with East-to-West orientation (2-tailed t-test, df=10, P=0.01). Interestingly, there was a significant difference in activity, with horses being more active in pastures with East-to-West oriented shade vs North-to-South (2-tailed t-test, df=10, P<0.01). In conclusion, horse shade use behaviour was not affected by increasing THI at levels observed in this study, however shade orientation and animal gender may play a role in overall shade usage.

Lay person message: To determine if horses use shade structures more or decrease movement when the combination of temperature and humidity are high in Arizona, GPS collars were used to measure movement and time spent near shade. We also analysed whether shelter orientation (long side East-toWest vs North-to-South) affected shade usage by the horses. The shade use behaviour was not affected by increasing temperature/humidity levels observed in this study, however shade orientation (North-to-South oriented structures had higher use: 18.7% vs 14.2%) and animal gender (geldings vs mares: 20.3% vs 13.8%) affected overall shade usage.

Keywords: equine; behaviour; shade; heat stress; GPS.

Validation of the Orscana sensor to monitor equine thermal comfort

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Technological devices are now available on the commercial market, advertised to remotely monitor the thermal comfort of rug-wearing horses. However, the accuracy and reliability of these devices must first be established to confirm their validity. This study aims to evaluate the ability of the commercially available Orscana Sensor to monitor the temperature, humidity, and 'comfort' of stabled horses. A sample of mature horses of mixed breed from a college herd (n=6), were studied during November/December. Horses were housed in individual loose boxes, with rugs added consecutively every hour to induce a temperature increase. Orscana sensors were fitted to each horse according to manufactures guidelines, located in the hollow area below the left point of hip. These devices were set to measure under-rug temperature (°C) and humidity (%RH), and to provide a warning when horses became thermally 'uncomfortable'. iButton data loggers (Thermochron®, DS1921G-F5, Australia.) were secured directly to the horse's body with duct tape, located at the hip and wither, and took temperature readings every minute. Environmental factors (temperature, relative humidity, black globe temperature, and WBGT index) were also monitored for each hour. The results provided by the Orscana were compared to iButton readings, visual observation of behaviour (scan sampling of each horse on the day of the study at 10 minute intervals, followed by a continuous assessment of video footage from each stable, both utilising a pre-determined ethogram) and physiological assessment of the horses similar to those available to horse owners (rectal temperature, respiratory rate, and a subjective 'sweat score'). A linear increase in both wither ($y = 0.179x + 29.7$, $R^2=0.96$, $P>0.001$) and hip temperature ($y = 0.154x + 29.3$, $R^2=0.97$, $P<0.001$) was shown by the iButtons® as rugs were added. The Orscana showed a similar linear temperature increase ($y = 0.231x + 24.6$, $R^2 = 0.97$; $P<0.001$) although as expected did read ~3°C lower than the iButton® temperatures as these were in direct contact with the horses' coat. The device is therefore considered suitable for use by the lay horse owner to monitor the temperature of stabled horses. Additionally, the same temperature increase was not felt by researcher checks, and no horses were observed to display any signs that may be associated with thermal stress despite both devices indicating that all horses reached temperatures above their proposed thermoneutral zone, thereby suggesting that the use of this sensor may be superior to traditional methods available to the horse owner.

Lay person message: It is believed that some owners may judge their horses' thermal comfort based on how they themselves feel and may subsequently over-rug, leading to equine discomfort. A solution may be to use the 'Orscana Sensor', advertised to measure the temperature and humidity of rug-wearing horses. This study investigated these claims and found that this device is a useful tool, able to reliably detect and indicate when horse under-rug temperature increased, even when this could not be seen by researchers utilizing methods available to any horse owner. Its use could, therefore, be beneficial to guide rug selection based on individual requirement.

Keywords: technology validation; temperature; humidity; monitoring; stable.

PL9

Horse welfare assessment with animal based indicators

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The welfare of the horse should be considered a top priority in equitation. There is concern about equine welfare among European citizens due to increased public awareness and to limitations of the present legislation, which differs between countries and does not encompass all aspects of welfare. In addition, assessment of equine welfare can be challenging due to the considerable diversity in the use and management of horses. The Animal Welfare Indicators (AWIN, EC FP7 research project) developed practical assessment protocols concerning on-farm welfare of several animal species, including horses. The approach was based on the method defined in the Welfare Quality® project that described four animal welfare principles: *Good feeding, Good housing, Good health and Appropriate behavior*. The development of the protocol required the following: i) selection of potential indicators; ii) bridging knowledge gaps; iii) stakeholder consultation; iv) testing of the model protocol on-farm; v) development of an application for data collection and analysis. Adopting the AWIN framework approach, we will present recent advances on research about indicators related to the four welfare principles.

Good feeding: currently two welfare criteria are proposed to assess good feeding. They include appropriate nutrition, with the indicator Body Condition Score (BCS), and absence of prolonged thirst, with the indicators of water availability and the bucket test. The proposed BCS evaluation is based on a 5 point scale performed with a standardised method that assesses the quantities of fat deposit in specific areas. Visual and physical palpation of the fat deposit should be performed by a trained operator giving a score according to the absence or presence (thickness of fat) in the specific fat deposit. A BCS that is not close to the medium values of the scale requires particular attention. Very thin or emaciated horses in many situations require an immediate intervention by the caretaker, but also overweight and obese animals should be identified. An increase of the body condition predisposes to specific diseases such as laminitis that can compromise welfare in the long term. Owners may fail to recognise fat animals since the neck appearance and the round shape of the body can be confounding factors. The evaluation of the water availability should be based on the actual availability of water and not only on the presence of the water bowl or tank. The water point should be clean and functioning or be filled regularly to allow the horse a constant access to water. A bucket test should be performed to evaluate the horse thirst in any situation where doubts can arise.

Good housing: while at present the evaluation of housing conditions during official controls is often underestimated, or thoroughly considered only in extreme situations, its objective assessment is of great importance. The criteria currently proposed for assessing good housing are: comfort around resting, thermal comfort and ease of movement.

Good health: the assessment of health should include both physical and mental health. The assessment of physical health is well established and should be performed by veterinarians following accurate health check list, including presence of injury, lameness, and diseases affecting the body systems (e.g. respiratory, gastro enteric, urinary). However, basic health checks should be conducted by owners and caretakers to identify animals in the early stage of disease and to obtain veterinary assistance. Monitoring systems of basic clinical

and behavioural parameters are useful to the early detection of health problems. Diseases, injury and lameness are associated with pain. Composite pain scales combine clinical and behavioural parameters and requires touching the animals. More recently developed pain scores can be applied without disturbing the animals and reducing the risk of injuries for the examiners. This pain scoring should be routinely performed in equine stables and hospitals. Behaviour may be used to assess mental health, but there are still many gaps of knowledge on how to assess mental health.

Appropriate behaviour: although most horse people would claim that it is reasonably easy to recognise the affective state of a horse, it remains difficult to substantiate it or to explain how to do it. Qualitative behaviour assessment (QBA) is a scientific method that has been proven to contribute to the identification of the main dimensions of animal emotional states. The fixed QBA term list developed for the AWIN protocol was applied to the study of horses' relationships with humans and their relation with the animal emotional state, further investigating the feasibility and reliability of QBA in on-farm conditions. Horses perceived as more relaxed/at ease with QBA showed less avoidance and responded less aggressively and fearfully to human presence during behaviour tests. These results support the hypothesis that QBA is sensitive to the quality of human contact in horses.

The Italian Ministry of Health, in collaboration with the University of Milan and the Italian Equestrian Sports Federation, decided to adopt the AWIN welfare assessment protocol for horses as a tool to improve the quality of veterinary official controls, with the aim of increasing the protection and welfare of horses. Still, there are important future challenges to be addressed in the field of equine welfare assessment. Research is needed to better define the sensitivity of animal-based indicators and to include the temporal component in the assessment of welfare. Neuroscientists have started to give attention to large-brained farm animal species and cross-fertilization between research in neuroscience and animal welfare is likely to bring important developments for the benefit of the quality of life of both animals and humans.

Lay person message: Assessing the welfare of horses is a complex procedure including an appropriate evaluation of diet, management, housing, physical and mental health, and behavioural repertoire, using animal-based indicators. The assessment of welfare should be conducted routinely in equine stables and hospitals to implement the early diagnosis of any welfare concerns, reducing prolonged pain and suffering and avoiding cases of neglected horses.

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Preliminary study to develop a standardised welfare assessment protocol suitable for assessing the welfare of horses residing in two UK charities

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Animal welfare can be assessed through resource inputs (e.g. pasture/housing systems, diet, veterinary interventions and groom competency), and animal-based outcomes (e.g. lameness, diarrhoea, demeanour and aggression). The Horse Trust is a charity in England that aims to demonstrate excellence in equine care at its sanctuary. The organisation sought to develop a welfare monitoring programme to measure how resident horses coped with the resource-inputs provided to them. There are approximately 7,000 equids in the care of welfare charities in the UK and such a programme may be of use to other charities. This study describes the first stage in developing a valid and reliable welfare assessment protocol (WAP). The aims were to: i) develop a WAP incorporating animal-based measures that was suitable for field use; ii) identify the prevalence of health and behaviour parameters in a population of horses resident at charities in England; and iii) identify associations between the measures to provide further evidence of validity. Using information from published literature, field experience and stakeholder surveys, a WAP was produced that incorporated measures capable of collectively assessing the five needs outlined in the Animal Welfare Act 2006. It was tested in a cross-sectional study on 83 horses resident at two welfare charities in up to three different contexts (stable, field and when restrained in a head collar). All data were collected by one person (LP). Statistical analysis included Pearson's Chi-squared test, Fisher's Exact test, Mann-Whitney U test, Spearman rank correlation and Principle Components Analysis. Most horses were admitted because of welfare compromise (47.3%). The most prevalent measures were limb swelling (48.6%), lameness (36.5%), hoof cracks (36.5%), wounds (24.3%) and diarrhoea (17.6%). Lame horses were significantly more likely to have limb swellings (χ^2= 11.000, df=1, P=0.001) and spend a greater proportion of their time with their head down below wither level during the restrained assessment (median=0.18, IQR=0.36, U=416.000, z=-2.539, P=0.011). Agonistic behaviours were significantly more frequent with greater numbers of horses in the field (r=0.267, P=0.022). Most measures were suitable for field use but some required refinement e.g. demeanour. The WAP enabled the identification of conditions that required further monitoring, environmental/management changes, veterinary intervention and/or further training of the horse. The data obtained from the two charities may not be representative of the horse population residing within all UK charities. This was a preliminary study and future research should focus on assessing the inter- and intra-observer reliability of the WAP.

Lay person message: Assessing a horse's health and behaviour makes it possible to determine how well it is coping with its environment, diet, husbandry and veterinary interventions, and the competency and handling skills of the people caring for it. A standardised protocol for assessing health and behaviour measures was produced and tested under field conditions on 83 horses resident at two welfare charities in England. The protocol enabled the identification of conditions that required further monitoring, environmental/management changes, veterinary intervention and/or further horse training. Future work should focus on ensuring the protocol can be used consistently by the same person, and multiple people.

Keywords: equine; horse; animal welfare; welfare assessment; horse-human-relationship; rescue.

Monitoring herd health in donkeys using welfare assement and clinical records

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The Donkey Sanctuary (DS) is an equine charity whose mission is to "transform the quality of life for donkeys, mules and the people that depend upon them worldwide". In the UK, The DS cares for over 2000 donkeys on a number of farms varying in size from 250-580 animals. The farms aim to rehome up to 10% of their herd annually to guardian (private) homes or donkey assisted therapy centres. The farms also provide a show case for our work to visiting professionals and the public. Welfare of the donkeys on farms is critical to the credibility of the Donkey Sanctuary. Using welfare-based criteria alongside health records has enabled the teams to pro-actively monitor donkey welfare, refine management practices, re-direct budgets and track progress. Since 2017, the DS has been using the stage 1 AWIN (Animal Welfare Indicators), which are animal and resource based measures. AWIN is used on a quarterly basis on all farms to evaluate the following AWIN criteria: Appropriate nutrition (body condition score BCS), Absence of injuries (lameness, joint swelling, skin change, prolapse), Absence of disease (hair coat, faecal staining, ocular/nasal discharge, abnormal breathing, cheek teeth palpation), Absence of Pain (hoof neglect, lameness, hot branding), and Human-Animal Relationship (avoidance behaviours, tail tuck). The donkeys chosen are a random 10% at each visit using a named list of donkeys. This data is evaluated alongside information collected from a computer based Animal Management System, where vets input clinical conditions in pre-determined categories to monitor physical health - the main ones aligned are BCS, lameness, colic, hyperlipaemia, sarcoid, eye disease, and mortality rate. Over 1 year at 1 farm with 580 donkeys: AWIN showed (i) loss of weight control over summer with total animals BCS >4 (scale 1-5) increasing from 13% in January to 31% in September, (ii) lameness peaking on turnout (from 6-15% herd), (iii) skin disease (relating to lice burden) decreasing from 32% (winter) to 7 % summer, (iv) hoof neglect (thrush, abscesses) remaining high all year at >50%, (v) avoidance behaviours constant at about 12%- relating to new animals arriving and calm animals leaving. Data is recorded in Excel, and presented graphically and by written documentation. Quarterly meetings with the farm manager and staff enable timely feedback. Welfare can be benchmarked across farms and improvements aimed for. AWIN is validated and straightforward to use.

Lay person message: Traditional herd health monitoring is based on veterinary morbidity/mortality figures using historical data from computerised records. The Donkey Sanctuary has responsibility for a large number of rescue and rehomed donkeys on farms whose welfare is high priority. The DS has introduced a validated welfare assessment tool to be used four times a year, to monitor animal and resource based measures of welfare (AWIN). This allows information to captured in real time rather than retrospectively and adverse welfare can be identified. Using this tool allows evidence based management changes to be made.

Keywords: donkey; welfare; herd- health; management; charity

Exploring public perceptions of equine welfare scenarios using a positive approach

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The topic of equine welfare is often controversial and elicits strong, and many times, negative emotional responses when discussed by the equestrian public. In the field of positive psychology, studies focus on the strengths within individuals and communities that allow these entities to thrive, which corrects the imbalance of constantly focusing on negative aspects. The use of positive affect and interventions with people have been shown to enhance qualities such as decision-making, problem-solving, empathy, and creativity. The purpose of this study was to explore how a positive approach could be used to assess public perceptions of horse welfare and to identify what cultural factors influence how people identify good horse welfare as defined by the Five Domains. This mixed methods study was done through an online survey questionnaire through convenience and snowball sampling on social media (N = 259). Data was analysed using descriptive statistics, frequencies, and qualitative thematic analysis. Participants were presented with 5 pairs of horse scenarios which corresponded to each of the Five Domains and asked to indicate which of the scenarios they believed to be the most positive situation and aspects in regards to welfare, as opposed to identifying the most problematic. These scenarios provided details regarding each horse's every day exercise regimen, nutrition, and living situation. The majority of participants indicated having five or more years of horse experience (95.8%) and being horse owners (89.6%). Participants indicated that 60.0% attend and participate in horse shows and 49.0% house horses at their home. Scenario choice and thematic coding indicated that factors such as turnout, adequate shelter, age appropriate exercise, and the ability to "just be a horse" were indicated as the most positive aspects between scenarios. Choices between the scenarios involving the nutrition domain and the health domain were the most evenly split between the pair of scenarios, while the scenarios involving the behaviour domain were heavily skewed towards one scenario (86.1%) with turnout and ability to express natural behaviours being the most common explanation. Qualitative analysis also indicated positive affect and excitement about the format and participation in the survey questionnaire. Overall, this study provides further insight into what welfarerelated qualities are of most priority to horse owners as well as the potential value of a positive psychology approach in the discussion of welfare views amongst the horse-owning public.

Lay person message: Horse welfare is a sensitive topic that often results in a variety of strong feelings when discussed in the horse-owning public. This study used a scenario-based questionnaire in a positive psychology approach to assess the public's feelings and discussions about horse welfare. Results indicated themes in important welfare qualities such as turnout, shelter, and ability to express natural behaviours, as well as a positive discussion about welfare. This study provides future implications for further research techniques in this area as well as communicative strategies surrounding equine welfare practices.

Keywords: disciplines; ethics; public perceptions; owner perceptions, welfare, equestrian.

The WELPA project: improving equine welfare in riding schools and livery yards through human behavioural change (HBC)

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At least 470 equine facilities are situated in Flanders (Belgium) and anecdotal data indicate there is room for improvement in the welfare of the horses stabled there. This study first examined the current daily practice at Flemish equine facilities through an online questionnaire (42 questions, 122 respondents/83 valid). The questions were based on the environmental parameters of the Dutch Equine Welfare Quality® protocol called "KPW" (covering all 12 WQ® criteria). Next, 13 facilities, small (n=12) to large (n=125), were recruited for a proof-of-principle demonstration project. In this project, a "spray and pray" workshop was combined with human behaviour change techniques to encourage facility owners to implement measures to improve the welfare of their horses. The owners could, voluntarily, improve their facility over an 8- month period, during which time they received additional support through HBC sessions. The KPW protocol was used to measure welfare before (PRE, June 2017) and after (unannounced POST, March 2018) the owners implemented changes. During the assessment, 20 randomly selected horses were evaluated per facility. Twenty-three environmental- and animal-based combination factors were assessed for each selected horse. In total, data were collected on 244 horses across 13 farms during the PRE assessment and 245 during the POST assessment. Feeding management improved significantly after 8 months, despite the POST assessment being in the winter period (PRE score 54 ± 21.0 vs POST score 68 ± 20.8 Wilcoxon Signed Rank $p < 0.05$). In 7/13 farms the order of their food type was swapped resulting in roughage being given after the longest interval between feeding moments; 5/13 increased the number of feeding moments and 5/13 distributed the feeding times better over 24 hours. Also, 5 farms started or increased the use of slow feeders (PRE: 37 horses with slow feeders, POST: 78 horses with slow feeders). At 12 facilities, at least 1-6 (management) improvements were made, such as significant adaptations of feeding practices or creating group-paddocks to allow daily turnout during mucking-out for horses who previously had once a week grazing. Four facilities had specific plans for, or started, structural adaptations (rebuilding, creating social contact options between neighbouring boxes; extra paddocks for winter turnout; etc.). In the questionnaire after the POST assessment, 11 owners mentioned they would not have made adaptations towards a better welfare without the HBC sessions. The proof-of-principle was successful, since most facilities improved (especially feeding and turnout management) and spontaneously mentioned relaxed and easier to handle horses.

Lay message: After a questionnaire investigating habits of equine management (n=122 respondents) 13 Flemish stables and riding schools were selected for a proof-of-principle project. The scientific WQ® type protocol (KPW) measured welfare at the start and end of the project. Based on the individual KPW assessment and an interactive workshop, stable owners were encouraged to take action to voluntarily improve the welfare of their horses. Support was given via individual HBC coaching sessions that provided owners with options and help for implementing welfare-increasing measures. Twelve stables implemented at least 1-6 adaptations to housing and/or management. Especially feeding regimes improved significantly.

Keywords: Welfare Quality® Protocol; human behaviour change; riding schools, welfare, feeding practices; turnout.

Do equestrians have insight into their equine–related knowledge (or lack of knowledge)?

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It is widely accepted having insight into one's ability and performance is an essential part of being a professional. Self-evaluation, self-efficacy and confidence are key factors in any successful career. The Dunning-Kruger (DK) effect is a well-known effect regarding performance and knowledge. There is minimal research evidence investigating the DK effect in athletes and sports. Equestrianism is a popular lifestyle and growing sport across the world. The aim of the current study was to establish whether equestrians have insight into their own equine knowledge or whether they over/underestimate their knowledge demonstrating a DK effect? The present study included non-equine (n=123) and equine (n=128) participants with different educational achievements (none, low, medium, high qualifications). Participation was voluntary via an online study. Ethical approval was provided by University Centre Hartpury ethics board. The non-equine group were asked to answer 40 general knowledge questions. The equine group were asked to complete 40 specific equine related questions. All participants were subsequently asked to estimate whether they felt they had answered the questions correctly. Analysis comparing actual mean score with self-estimated mean score demonstrated that: 1) non-equine participants irrespective of educational background were accurate on their abilities to predict their general knowledge (Paired t-tests: $P>0.05$); 2) actual mean score compared with self-estimated mean score for the equine participants demonstrated an over estimation of their equine knowledge regardless of qualification level (Paired t-test: cohort: $P=0.0001$, $t=4.0$, $df=127$, 15±5% over-estimation; by qualification level high: $P=0.01$, $t=2.6$, $df=26$, 15±6% over-estimation, medium: $P=0.006$, $t=3.0$, $df=26$, 19±6%, low: $P=0.02$, $t=2.5$, $df=42$, 12±6%). This preliminary study found all equestrians had an inflated confidence in their equine related knowledge indicating that equine related individuals have only moderate insight into their abilities. This study is the first to provide evidence of a form of the DK effect within the equine population. Future research must address the role of contextual factors i.e., whether the effect is limited to equine related material only. Furthermore, research is required to investigate over estimation of physical skills for example riding or horse care management and performance. For the equine industry the findings from this preliminary study are very alarming and raise welfare, mental health and safety concerns. Our study supports the need for further research investigating DK effect in the general field of sport psychology for example the effect on 'coachability' of riders.

Lay person message: No doubt you have experienced a situation where someone's performance is below average however they are confident their performance is excellent. This is the Dunning-Kruger effect in action. This is the first study to demonstrate horse riders over estimate their knowledge indicating an overconfidence. Horse riders think they know more than they actually know. This over confidence can have serious consequences on the welfare of horses, could affect the mental health of riders, and raises important safety issues to the rider and horse.

Keywords: equestrian; Kruger Dunning Effect,; welfare; sport psychology; confidence; knowledge.

Conspicuity equipment and its contribution to the welfare of horse and rider combinations using the road system in the United Kingdom (UK)

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Limited research exists in the field regarding proximity of vehicles to slower users of the UK road system and effect of types of conspicuity equipment. Previous studies stated over 60% of horse and rider combinations experience near miss traffic collisions in any one year, while use of fluorescent/reflective (FR) items did not decrease occurrences. Similarly, research into vehicle proximity to bicycles reported no significant distance increase with cyclists wearing FR. This study undertook a similar field experiment but using a horse and rider wearing different conspicuity equipment to ascertain which one might increase proximity distance and therefore reduce near misses. A rider rode either one of two chestnut horses with similar height, age and temperament using four conspicuity measures 60 times each (n=240) along a straight half-mile lane. Measures were chosen by random crossover with two selected for each separate trip. These were a fluorescent/reflective (FR) tabard, a novel black/white pattern (PB) tabard, lights on a helmet (L), and control of mid-blue (C). Using MiniTab 18© a Wilcoxon Signed Rank Test reported lane median width as 4.863 metres (m) from the position of the combination to the opposite hedge boundary. Ridden trips took place between the hours of 1700 and 1900 in clear daylight without any precipitation. Approximately seven hours of riding over one month were undertaken using a novel proximity meter mounted on the saddle pommel. The meter activated when a vehicle was parallel to the combination and it detected proximity by laser beam. Distances and approach from the front or rear were logged into a realtime voice recorder. Analysing vehicle approach data with a non-parametric Friedman Test reported nonsignificance ($CH2=4.40$, $P=0.355$), therefore as many vehicles approached from the front as from the rear. An analysis of variance (ANOVA) reported there was a significant difference between all measures and proximities observed ($S=0.449981$; $df=3$, $P=0.000$: L median=2.49m; range=2.3755-2.6044; FRS median=2.3078m; range=2.1933-2.4222; PB median=2.5204m; range=2.4060-2.6348; C median=2.1025m; range=1.9881-2.2170.). A further series of Mann-Whitney tests reported there were significant differences between C compared with L, PB and FR ($W=4402.00$, $P=0.000$; $W=4564.00$, $P=0.000$; $W=4161.00$, $P=0.005$) respectively. When L were compared with PB there was no significant difference in distance ($W=3640.0$, $P=0.958$), however when FR was compared with L and PB, only PB showed significant difference in distance ($W=4044.0$, $P=0.030$). Therefore, results may suggest that wearing any of the measures outperforms C, and PB outperformed FR in assuring greater proximity from approaching vehicles.

Lay person message: With road incidents involving horses on the rise, the welfare of horse and rider combinations using them is extremely important. This study investigated if wearing different colours or lights when riding had an impact in decreasing the proximity of vehicles to combinations. A significant increase of distance in the proximity of vehicles to riders occurred when wearing lights, fluorescent/reflective and patterned tabards compared with a neutral colour. Overall, black/white pattern tabards and lights were more effective at increasing the proximity of the vehicle than any other measure, and pattern tabards more effective than fluorescent/reflective tabards.

Keywords: road safety; welfare; conspicuity measures; rider safety; horse safety.

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A place for welfare and wellbeing – young riders' thoughts about the future riding school in Sweden

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Young riders' thoughts about the future riding school can contribute to a greater understanding of how they perceive and experience educational equitation. Allowing young people to think freely is highly relevant from the perspective of children's rights. In addition, children's health can be connected to factors such as meaning and motivation. Furthermore, it also provides knowledge about how to design equestrian education for young riders in relation to equine welfare. The aim of this study was to explore how young riders express and collectively discuss the future of Swedish riding schools. Following questions have been included: What advantage and disadvantages do the young riders experience with today's riding schools? How shall future riding schools be designed? Five focus group interviews were conducted at riding schools by a moderator among a group of 5-9 young riders. The results were analysed with a sociocultural perspective focus on interaction and communication. A qualitative content analysis has been used as an analytical tool to identify and categorize patterns in the empirical material. The preliminary result showed that the young riders discussed the future riding school in relation to failures of the present riding school. Many things were perceived as good but the young riders pointed to how these things could be improved. For example, accessibility and inclusion needs to improve and there must be activities for all at all levels, regardless of age, gender, ethnicity, disability and social economic factors. In addition, they emphasized that riding instructors needed more education in pedagogics and social skills. Another thing stressed by the young riders was that it is important to change the societal gender order so that boys can join the riding schools' activities without being bullied at school. The young riders pointed to the importance of the welfare of riding school horses. According to them, the horses should have large outdoor paddocks and have their own box or be kept in active stables. There was also a wish for that the municipalities to invest more in riding schools since many riding schools have old facilities. Finally, the social atmosphere in the riding school was to (continue to) be characterized by security and fellowship. In conclusion, this study explored young riders' perceptions and the discussions revealed political, economic, social and gender related problems and aspects which indicates important findings for riding schools, the Swedish Equestrian Federation and the horse industry.

Lay person message: This study explored how young riders in focus groups collectively discuss the future of Swedish riding schools. The young riders perceived that there is a need for the riding schools to increase inclusion and obtain educated riding instructors. Welfare of the school horses was important as well as the social atmosphere. The results gave important insights from a child's rights perspective and revealed political, economic, social and gender related problems and aspects.

Keywords: equine education; human-horse relationship; child's rights perspective; social interactions; stable cultures; gender

Euthanasia is responsible ownership

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Responsible ownership is the cornerstone of the horse-human partnership. This is true for all equidae (horses, ponies, donkeys and mules), from those used for leisure to the high level competition animal, and from those used in tourism to the ones destined for slaughter. We, as humans, have domesticated equidae and as such must take responsibility for their health and welfare throughout their lifetime, from birth to death.

Decisions are made daily on how to best care for and meet the needs of equids, in order to both prevent suffering and ensure good welfare. Quality of life at all ages must be considered and owners and keepers must be prepared to make tough decisions to protect their horse's long-term health and welfare, including the decision to euthanase. It is rare for a domesticated horse to die of natural causes, so most will require either emergency or elective euthanasia. Even young or seemingly fit and healthy animals may require euthanasia because illness or accidents can happen at any time and at any age. Similarly euthanasia should be considered an option for physically healthy animals if their behaviour is dangerous or difficult and the owner is unable to manage them having made all reasonable efforts. It is unfair and irresponsible for any horse to be either mis-sold or rehomed without the new owner or keeper being fully aware of the animal's history and they must have the experience and skills to provide appropriate care and management for them. Often animals that are sold or rehomed irresponsibly end up in a spiral of decline, being passed from person to person, with the welfare becoming increasingly compromised. In many cases the most humane option for a horse that cannot be responsibly rehomed or sold is euthanasia.

Thinking about the death of an animal and making end of life decisions is (and always should be) a difficult and emotive process; however this is a key responsibility when owning or keeping any animal. The decision to euthanase is often delayed due to perceived ethical or moral conflicts or a lack of knowledge and understanding about which options are available and what would be the most appropriate for their horse. However, it is important that owners understand the potential impact that this delay can have on the welfare of their animal. In the UK, delayed death (i.e. the keeping of an animal alive when it is inhumane to do so) is one of the most significant welfare challenges causing avoidable suffering to thousands of horses each year.

Options available for euthanasia and associated challenges differ depending on the country and the status of the animal. In some countries elective euthanasia is only possible if a veterinarian confirms there is no reasonable recovery for the animal and its quality of life is severely affected, however this may not be applicable to behavioural or performance related issues. In other countries owners have a much greater say over when to euthanase and have a range of options available. Cost may also be an issue, and it is important that owners not only factor in the price of euthanasia but also the fee of carcass removal and disposal – depending on the method used the cost can vary significantly. Slaughter for human consumption can also be an option in some countries, so long as the horse is eligible for the food chain, is well enough to travel to the slaughterhouse and is transported and slaughtered in compliance with current regulations. However this option is often disregarded due to the stigma associated with this end of life choice. Regardless of the method used, euthanasia must always be undertaken humanely and meet OIE standards as a minimum. Inappropriate methods such as illegal slaughter or the use of inappropriate drugs will always result in poor welfare, and should never be considered.

Conflict and dilemma surrounding euthanasia are also evident in the world of equine

sport. When a high performance equine athlete can no longer compete at a top level due to injury, behaviour or reduction in performance, the animal is often sold, rehomed or retired. These may be good options for many animals but certainly not all. It is widely accepted that it is unethical to profit from horses without fully providing for their health and welfare, and so it is the social responsibility of all equine sporting bodies to ensure that any horse involved in sport is protected throughout its life, including promoting a responsible approach to breeding. And a horse in chronic pain or one that does not have the temperament to adapt to life outside of the rigours of the sport, should not be made to live out its life with physical or mental suffering and a humane death may be the most ethical, responsible option.

Veterinarians are ideally placed to provide support and guidance to owners during end of life discussions. It is important that all available options are discussed and that the animal's welfare is prioritised throughout. Cultural and religious beliefs relating to euthanasia in some parts of the world can be a challenge but, handled sensitively, acting in the best interests of the animal can often overcome this issue. In all cases, the equids quality, not quantity, of life must be the prime consideration when deciding when the time is right and which method of euthanasia will be used.

Lay person message: Responsible horse ownership means providing good husbandry and care throughout the animal's lifetime, including providing a good death. Deciding to euthanase a horse is never an easy decision but it is one that most owners will face at some point in their horse's life, and can occur at any age and in all types of horse. Sport horses are equally at risk of suffering due to delayed euthanasia. Being prepared and discussing all euthanasia options with a veterinarian can help ensure this decision is made at the right time. Quantity of life should never be prioritised over quality of life.

Keywords: welfare; euthanasia; responsible; ownership; equidae; ethics.

"Bear in mind that in riding struggling and pulling is too easy and too often harmful; very difficult and almost always useful, being able to let a horse do and know how to cede under any circumstances. And this essentially needs to be learned and taught. Anyone who is capable of ceding will always be able to pull in due time and to the right extent."

Carlo Giubbilei "Federico Caprilli, Life and Writings", p. 73

How to keep horses comfortable with routine healthcare procedures and to rehabilitate those with learned aversions

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Arelatively common behaviour problem among horses is aversion to one or more routine health care and/or grooming procedures. In our work at The University of Pennsylvania we have been encouraging veterinary students, veterinarians, and the horse owning public to apply non-confrontational handling methods along with learning science-based behaviour modification principles when performing health care procedures with horses. Our recommendation is to employ these methods routinely with all horses to avoid development of treatment or other procedure aversions. We also employ similar principles and practices to rehabilitate or to implement "least harm" strategies for emergency treatment situations for those patients with already well-organized, often dangerously animated escape/avoidance behaviour. The common specific procedure aversions among our hospital patients or behaviour service consults include difficulties with: intramuscular and intravenous injections, oral medications, eye medications, intranasal vaccination and insertion of a rectal thermometer. For each of these types of procedure we have developed tips on what aspects of commonly provoke escape and avoidance behaviour, how to reduce or avoid those negative aspects, how to avoid inadvertently shaping increasingly animated and dangerous escape/avoidance responses, and recommendations on rehabilitating horses with problematic wellestablished avoidance behaviour. Examples of important behaviour modification concepts that generalize to any healthcare procedure include: (1) For each individual horse and facility, carefully consider what level of restraint will be most effective at guiding without over-confining or otherwise punishing the horse; with any known tendencies for avoidance in mind, consider what method of restraint will likely effectively interrupt those known avoidance responses with least negative consequences, (2) Begin and end each procedure with positive interaction (positive reinforcement) and use positive distractors (scratching at the withers, food treat) where effective, (3) Carefully consider how you can make the procedure itself as pleasant as possible for the horse and for the people; examples include the most comfortable environment available, the smallest gauge needle that will work, mouth friendly oral dose syringes, warm intranasal vaccine and applicator if cold in winter, (4) When administering treatments stabilize the hand applying the treatment against the horse such that should the horse move, contact can be maintained in a relaxed manner; breaking contact during movement accidentally trains the horse to avoid, and can lead to unnecessarily discomfort by poking sensitive tissues as the horse moves, (5) Ignore any undesirable responses, and remain as relaxed as possible while focusing on reinforcing increments of the desirable behaviour (relaxation and compliance) with well-timed food or tactile rewards, (6) Counter-conditioning in the form of teaching the horse an alternate response that is incompatible with the problematic avoidance behaviour is often quite effective, (7) While negative reinforcement as the principal behaviour modification strategy may be effective in some instances, in our experience it requires much greater skill to avoid inadvertent punishment than do positive reinforcement strategies. In summary, a central theme to this approach to helping horses to be comfortable with, or at least safely tolerate, mildly aversive healthcare procedures involves handlers' understanding of learning principles, along with willingness and ability to adjust their own manner and behaviour modification strategy to make the experience more positive, more efficient, and safer for both horse and handler. Full manuscripts describing these methods can be found at:

http://www.vet.upenn.edu/docs/default-source/research/equine-behavior-laboratory/mcdonnell---preventing-and-rehabilitating.pdf?sfvrsn=9583e1ba_0

http://www.vet.upenn.edu/docs/default-source/research/equine-behavior-laboratory/how-to-injection-shyness.pdf?sfvrsn=fa27e0ba_0

http://www.vet.upenn.edu/docs/default-source/research/equine-behavior-laboratory/foster---understanding-and-implementing-principles.pdf?sfvrsn=4680e1ba_0

http://www.vet.upenn.edu/docs/default-source/research/equine-behavior-laboratory/2018-torcivia-and-mcdonnell-rehab-aversions44dc8470bc1662488b01ff0000cb9282.pdf?sfvrsn=7dcae6ba_0

Lay person message: Health care and grooming procedure aversions, such as needle shyness, oral dosing head shyness, and clipper aversions are learned. Aversions can be avoided or rehabilitated by understanding and employing basic principles of learning.

Keywords: health care treatments; procedure aversion; behaviour; avoidance behaviour.

"In this way, free from all other concerns, the horse focuses all its attention on what it has to do, and gradually learns to better use its strengths and to perfect itself. Instead, when the horse is held in subjection by the rider and suffers his/her action, it incessantly looks for the pretext and the opportunity to escape it, and to this it turns all its studies, distracting itself, and diverting from the work it has to do."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 71)

Why and how to body condition score?

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The prevalence of obesity in equids kept primarily for leisure purposes is increasing which may reflect not only changes in the way animals are fed, managed and exercised but also in part the failure of owners and keepers to recognise when animals are starting to become overweight and/or a shift in their perception of what is an ideally conditioned animal. Therefore, increased use of routine monitoring of 'body fatness' needs to be encouraged in all involved with the management and keeping of horses and ponies. Whilst accurate stable isotope based methods have recently been validated for the quantification of total body fat %, these are not practical and routine monitoring typically depends on indirect estimates. Body condition can be inferred by animal-based morphometric indicators that describe the body's energy reserves in particular subcutaneous fat or adipose tissue. By means of a visual evaluation and palpation of key adipose tissue sites it is possible to estimate the body condition score (BCS) using a numerical scale. Different BCS scoring systems, based on 5- or 9-point scales, are available for horses and at the moment are the most commonly used methods to determine and monitor body condition. The reliable and reproducible use of any BCS system requires experience and skill and should be undertaken in a standardized way. The 9-point scale method, originally proposed by Henneke for breeding quarter horse and mares and later modified by Kohnke, has been validated against actual total body fat content in both horses and ponies in thin and moderate condition. An initial observation should be made, from the side and back at a distance of ~ 2.5m. This importantly enables the assessor to evaluate the possible presence or absence of key bony landmarks and provides a general overview of body shape. Whilst a visual inspection may provide an indication of the BCS, due to anatomical differences as well as variations in hair coat length and density, active palpation is required to determine the final score. Palpation of the fat storage sites should be performed in a consistent way starting from the neck region and then moving to the tail examining all 6 key body areas (neck, withers, shoulder, ribs, back, tailhead); each area is independently scored to accommodate individual differences in regional fat deposition. The individual scores are then added up and divided by 6 to give the final overall score for the animal. For each area points are given based on the descriptive 9-point scale (e.g. there is a description of what a score of one [very thin emaciated animal] in each area would look/feel like up to a score of 9 [obese animal]) and if the horse has intermediate characteristics between two scores, it is possible to use a half score. During the palpation it is essential to identify not only the presence of any fat deposit but also to evaluate its thickness and consistency. When there is no or little fat deposit the underlying bone may be easily felt under the finger tips or may be visible when the horse is really thin; however as the fat starts to accumulate the consistency can change depending on the body area. For animals in overweight to obese states, most bony prominences/landmarks have already been obscured by fat, making clear distinctions between the higher BCS points difficult. The relationship between body fat and BCS is also curvilinear meaning currently obesity is defined as an animal having a BCS of 7 or more/9, at which point an active change in diet and management is needed. It is therefore important for everyone to become familiar with one type of BCS system and to apply it in a consistent and uniform way that is adaptable according to individual horse morphology. A more specific simplified system has been proposed to assess an important regional site of fat accumulation in the neck: i.e. the Cresty neck score (CNS: 1-5 point scale). To give a score the dorsal margin of the neck is palpated with both hands along the poll to the withers in order

to identify the amount of fat tissue. Fat tends to accumulate more in the middle section of the neck and, when present in abundance, gives the neck a "cresty" appearance that in severe cases can drop on one side permanently. The neck muscles help identify the line between the fat deposit and the musculature. Regional fat adiposity such as CSN may be associated with a higher risk of metabolic health problems and therefore should always be performed together with BCS.

Lay person message: The prevalence of obesity in equids is increasing and it is important for everyone to become familiar with one type of BCS system and to apply it in a consistent and uniform way. Both being severely underweight (taken as a BCS of 3 or less) or being obese (defined as a BCS of 7 or more out of 9) are associated with a higher risk of health problems. Therefore it is important to be able to carry out a BCS so that at risk animals can be identified as soon as possible and appropriate changes in nutrition and management put in place and/or veterinary advice sort.

Keywords: obesity; BCS; CNS; monitoring; management.

"....he gave him a beautiful dark bay mare who had such a hard mouth and insensitive jaws, therefore keeping her was very difficult and many times she got carried away. Caprilli studied the mare, mounted her and in a short time led her into a hunt, facing high fences with the mare perfectly in his hands, submissive to the rider's will. It is to be noted that, to control the bay he left the curb bit and used a simple snaffle bit, and such a thing, if it astounded who was watching the undertaking, was of great importance for the careful tireless everyday experimenter.... the use of the snaffle bit to hold a horse that is not used to feel the break, could result strange to many, because there is the habit in such cases to use a hard bit instead of such a simple bit."

(Carlo Giubbilei "Federico Caprilli, Life and Writings", p. 38)

How to assess fitness for transport of equidae

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Transportation is a welfare concern and it can trigger health problems. Transport-related diseases affect mostly the respiratory and the gastrointestinal systems; transport pneumonia, also known as shipping fever or travel sickness, and enterocolitis, are the most dangerous transport-related diseases. Either can be fatal. For these diseases fitness for transport has been proven to be a risk factor. Horses having inflammation in the airways or in the gut before travelling are more likely to develop those diseases during or after the journey. Based on that scientific evidence, the assessment of fitness for transport has been included and has become mandatory in many codes of animal transportation worldwide. For instance, in the Australian and European Codes (EC n. 1/2005), horses with a body condition score less than 2 out of 5, with a grade of lameness above 4 out of 5, with fever, clinical signs of colic, or with a prolapse or an open wound are not to be transported. In Europe, the person in charge of commercial transportation (i.e. the transporter) must be trained and able to assess fitness for transport. In Australia, for non-commercial horse transport it is recommended that the person responsible for the horse ensure that fitness for transport is assessed. However, in a recent survey conducted in Australia on non-commercial transportation only 76.6% of the respondents routinely assessed fitness for transport and almost all of them performed only visual examination. Those respondents reported that they knew when their horses were unfit at a first look. Unfortunately, assessing fitness for transport by visual examination only is not sufficient. The author recommends that before any journey, and particularly before a return trip from a competition (another risk factor for transport related disease), fitness for transport should be assessed by performing a systematic health check including a physical examination. The following vital signs should be recorded: sensory state, mucous membrane colour, capillary refill time, heart rate, respiratory rate, rectal temperature, lung and gut sounds. The presence of a bounding digital pulse, cough, nasal or ocular discharge, open wounds, prolapses, warm/swollen areas on the legs, lameness and any other clinical signs should also be noted. Finally, faeces and urine should be normal in terms of frequency, consistency, and colour. Horses should be transported only if the vital signs are within the normal ranges, and all other checks are negative. If the results indicate that the horse is unfit for transport, a veterinarian should be consulted. At unloading, a horse should also undergo the same health check, and if the results are different a veterinarian should be consulted. Assessing fitness for transport is therefore useful also as a comparison for the early detection of post transport diseases. Useful guidelines on how to assess fitness for transport have recently been published in Europe (e.g. Practical Guidelines to Assess Fitness for Transport of Equidae, available online). Finally, recent research concluded that horses with preexisting sub-clinical airway inflammation are likely at greater risk of developing respiratory disease during long-distance transport. Therefore, before journeys exceeding 8 hours, it is prudent to consider having a veterinarian perform respiratory endoscopy to confirm healthy airways.

Lay person message: A famous motto says 'If you let a sick horse travel, you will end up with a sicker one'. The assessment of fitness for transport is mandatory in the regulations on live animal transportation in some countries. For commercial transport, only severe injuries and disease legally constitute unfitness for transport. Assessing fitness for travel before every journey and avoiding transport even in presence of less serious or subclinical diseases are strongly recommended. Better safe than sorry!

Keywords: fitness; transport; horse; health; welfare

How to prevent and manage horse barn/stable fires

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Barn/Stable fires occur regardless of demographics, wealth or geography. Horses rely on humans to provide the five freedoms – including shelter – and implies that horses should remain safe while housed. Accurate information on effective prevention, mitigation and response strategies for barn design and daily management is increasingly problematic in today's online world, and minimal scientific research into best housing exists. Owners, facility managers, veterinarians and design architects are forced to sift thru a mountain of conflicting information of dubious value to prevent barn fires. Review of numerous actual barn fires has demonstrated that evacuation response times for these incidents must occur within an average of 5-7 minutes from ignition - to be able to remove animals with minimal injuries from toxic smoke inhalation. The combustible characteristics of barns (electrical service, wood or partial wood construction, bedding and fodder, etc.) contribute to these challenges. The understanding of lay responders to actual barn fires is often based upon equestrian urban myths, speculation, TV/movie portrayals, and horse-keeping traditions instead of fire science and attention to horse behaviour under stress. Minimal educational materials describing effective response are available, but evacuation simulations in numerous horse barns across the United States and Canada have demonstrated the mathematical improbability of removing all horses in a timely manner. Practical recommendations to make response timely (runout plan set up, smoke/flame detection and alarm installation, proper suppression, regular evacuation practice with staff/boarders/students, and stall access provided from the outside wall) will be discussed to improve outcomes based on the fire science available. Evacuation - once a fire ignites, must be efficient - there are very few incidents in which all animals in a burning barn are evacuated, even when people are present at ignition. Horse owners, stable managers, barn owners and boarders consistently underestimate the risks and difficulty of evacuating a burning barn under actual conditions of fire, smoke and environmental factors – this practical demonstration will provide practical, tested methods for shortening evacuation times.

Lay person message: Prevention and response information provided to equine enthusiasts often fails to address key strategies in design, management and upgrades recommended by fire service personnel for facilities. Evacuation responses can be improved with training and practice as will be demonstrated.

Keywords: barn; stable; fire; welfare; design; management.

"...allow the horse to see and never force it to move forward before having observed; leave it free and do not obstruct it, and give release at the right moment."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 88

How to communicate with your horse freely

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When training a horse from the ground the most frequently used senses are sight and touch. Even the most elaborative horse liberty performances or the behaviours that seem to be generated by some sort of natural instinct, can be associated to an initial shaping phase organized by the rules of operant conditioning followed by a classical conditioning phase where the horse selects a cue that will predict and trigger the behaviour. During the operant conditioning phase, the touch sense, with the use of pressures as primary reinforces, is the most pertinent channel of communication to be used. Visual cues are mostly used in the second phase to generate signals that will be used as secondary reinforces. An important concept to remember is that while the pressures that generate the behaviour are selected by the trainers, the cue that predicts the behaviour are selected by the horse. Sometimes the horse chooses predictors that are not the one intended by the trainer creating confusion and stress. Confusion and stress is also generated by inaccurate timing during the use of reinforces. A correct knowledge of the learning theories demystifies and makes easy liberty training.

Lay person message: the knowledge of how to use pressures and their relies to generate horse behaviours and the ability to associate those behaviour to visual cues, is all its needed to shape complex liberty horse performances

Keywords: learning theory; free moving horses; operant conditioning; classical conditioning.

> *"Firstly, I will say that the peculiarities of vicious horses are such because the work failed to be adapted with the due progression and because they experienced unnecessary pains during it. Therefore, the horses tainted in this way, as soon as they will be ridden in such a way as to prevent them from pain by the rider, they will soon work well."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 88)

How to communicate with the horse under saddle

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When riding a horse, the tactile sense becomes the predominant way to communicate with the horse. Pressure (no) and the release of it (yes) becomes a binary code that the rider uses to communicate his requests to the horse and to shape all desired behaviours. It is important to remember that there is a temporary sequence that needs to be followed in order for the binary code to be successful. Pressure means, I do not like what you are doing, try something else. At that point, the horses start emitting random behaviour until the desired behaviour is performed. In that instant, the pressure is released and this signals to the horse, yes, that is what I am looking for. A subsequent application of the same pressure will make the horse repeat the desired behaviour without the trial of random behaviours, as the horse now has made the association between the request and the proper response. This seems a straight-forward training sequence: application of the pressure, desired behaviour performed, release of the pressure. Unfortunately, due to rider errors related to lack of knowledge or physical inability to deliver the aforementioned training sequence, the rider inadvertently rewards the horse for performing undesirable behaviours, such as rearing, bucking, kicking out, etc. The horse becomes uncooperative, not because it is challenging the rider, as is often believed, but because it has been trained to perform undesirable behaviour from poor timing during the training sequence, which can create a state of stress for the horse. Proper knowledge of learning theory and specific biomechanical exercises targeting the rider's ability to maintain constant pressure until the desired behaviour is performed has shown promising results in the reduction of the undesired behaviour and increased capability from horses to understand the desired response.

Lay person message: Sometime during training, horses start performing undesired behaviours. Most of the time this happens not because the horse is challenging the rider but because the horse is convinced that the rider is asking for those specific behaviours. Educating riders on learning theories, teaching them timing with appropriate exercises to improve the physical competency to deliver steady pressure requests, have shown successful result in preventing the onset of undesired behaviours.

Keywords: rider horse communication; negative reinforcement; stress; learning principles.

> *"I believe instead, that we should tend to keep the horse as it is in the wild, with a natural balance, with a natural head position, because of the fact that if any alteration in balance is needed, it will be disclosed how the horse can accomplish it on its own at work, when it is left the appropriate freedom."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 70)

How to become a champion

Athletes panel discussion

For some people, riding a horse comes naturally. For others it is not so simple. Those who are not naturally talented often think it's impossible to achieve good results. But what does it mean to be a "natural"? It usually means that the rider effortlessly achieves. When a rider cannot do this, they often think they are never going to able to because they are just "not a natural". This is because riding is not just an athletic sport. We use our bodies to communicate with the horse. We use a binary language that follows the structure of operant conditioning. Pressure means no, while release of the pressure means yes. The movement of riding a horse is a constant pressure and release of our bodies. This is where "natural" riders instinctively synchronize their pressure and release with the binary code required for communication. For the "unnatural" rider, does the limitation reside in the physical inability or does it reside in lack of knowledge? For the majority of these "unnatural" riders, it is the later. Multiple training exercises have been developed to help the "unnatural" rider synchronize their body movement with the binary code required for communication with the horse.

To give an example, everyone is born equip with a voice, however singing comes easily to some while highly difficult to others. Factually, there are very few truly out of tune people. The majority of people who cannot sing are just not properly trained. Specific singing exercises can help to achieve great results. This translates to riding horses. Most of us are born with the ability to move our bodies and build strength. However, to ride a horse you need specific exercises to teach you how to use your athleticism to communicate.

Lay person message: To become a successful rider you need to practice the right exercises that teach you how to use your body for athletic movements as well as exercises that help to improve correct communication with the horse.

Keywords: riding, horse, competition, communication.

> *"Seeing them face obstacles 40 cm high at extended canter, completely attached to mouths of their horses and with spurs in the belly, he probably thought that it was necessary to start education all over again and with no delay. The example was to persuade those [military ndt] dragons, who already believed to be riders and were not."*
>
> (Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 131)

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"We need to study that the support is always what is enough to be in contact with the horse's mouth, so that the horse always has the impression of being in the corridor between hands and legs; if this support, which through study, we will be able to use with the amount generally sufficient to adjust the horse, becomes twice or three times stronger than the one needed to adjust the horse it will be sufficient to disgust the horse and to make it more violent. This happens with the so-called "wanting to take the horse in the hand" with "wanting to put it in the support"

(Carlo Giubbilei "Federico Caprilli, Life and writings", p. 252)

The imprint of the rider's calf on the horse in a 3D model

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What does the horse actually feel from its rider and his leg aids? A theoretical 3D model provides some understanding of the basic mechanisms of the complex interaction between horse and rider. The model was developed in an open source program called blender. The basic data derived from models for the calculation of the centre of mass, human CT-scans and pictures of real horses and riders. The resulting 3D meshes were animated allowing a simulation of the leg movements of the rider. The amount of contact to the horse was calculated from the spatial vicinity of both objects, resulting in imprints of the rider on the horse's surface. Some biophysical facts have been integrated in the model. The possible movements of the rider's legs are limited by the human anatomy. The knee works mainly as a hinge joint, allowing a flexion and extension only in the plane formed between the femur and the tibia. The hip is a spheroidal joint offering much more possibilities of movements, but the adduction is limited by the horse's body. As a consequence only two free basic movements were possible to bring the calf closer to the horse: 1) a flexion of the knee, 2) an external rotation of the hip. The imprints of the legs on the horse's surface were different for the two movements. In this context an unilateral leg aid is an asymmetrical force acting on the horse that will create a counterforce. The horse will not only feel the pressure of the leg, but also the saddle pressure against the leg's direction of force. Therefore, the aids produce sensory signals of the force of action and reaction. The question rises to which one the horse finally reacts to. The results in the used setup were qualitative but they can be the basis for a future quantitative research.

Lay person message: With a 3D model the imprint of the rider on the horse was simulated. To bring the calf closer to the animal only two basic movements are possible: a flexion of the knee and an external rotation of the hip, both creating different imprints on the horse's surface. Asymmetrical aids generate a counterforce that may be crucial for the sensory perception of the animal. Understanding the mechanisms of communication between horse and rider is an important part of good training.

Keywords: 3D model; animation; horse-rider relation; leg aids; biomechanics.

animals

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Performance horse welfare: from good training to appropriate behaviour

Guest Editors:

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Deadline for manuscript submissions:
30 October 2018

Message from the Guest Editors

Dear Colleagues,

This Special Issue welcomes the submission of full manuscripts of abstracts presented at the 14th International Society for Equitation Science Conference. Manuscripts reporting research related to good training, good feeding, good housing, good health, appropriate behaviour, and the human-horse relationship will be considered with the aim to enhance and safeguard the welfare and the health of the performance horses during training and non-training periods.

Dr. Barbara Padalino
Prof. Sue M. McDonnell
Guest Editors

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Special Issue

Dually noted: the effects of a pressure headcollar on compliance, discomfort and stress in horses during handling

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Horses have evolved strong flight responses and handlers are often only 15% of the weight of their horses. Therefore, handlers sometimes resort to the use of "aids" to control their animals. However, there are increasing concerns about the efficacy and welfare implications of such devices, particularly when applied to sensitive facial structures. The Dually® head collar aims to increase compliance but little is known about the effects of this aid on behaviour or stress. The current study aimed to determine whether the use of a Dually® head collar improves compliance during handling in naïve horses and whether it increases stress or discomfort. Subjects completed two novel handling tests, one wearing a Dually® with a line attached to the pressure mechanism and one attached to the standard ring as a Control. Subjects were led over a blue tarpaulin and through streamers hanging from a pole, using appropriately timed pressure and release. Treatment and test order were randomised. The start of both tests was marked by a ground pole 2m away from the obstacle. Crossing time (first forelimb after the ground pole to last hind limb on/through the obstacle) and proactive refusal (motion away from the obstacle) were recorded as indicators of compliance. Core temperature and the discrepancy in temperature between both eyes were measured using Infrared Thermography (IRT) before and after each test as an indicator of stress. The Horse Grimace Scale (HGS) was used to measure discomfort. The Dually® did not result in more compliant behaviour, compared to the Control (crossing time: $T = 0.083$, $N = 18$, $P = 0.94$; proactive refusal: $U = 42$, $N1 = 9$, $N2 = 10$, $P = 0.538$). However, the Dually® did result in significantly higher HGS scores ($T = 2.49$, $N1 = 8$, $N2 = 9$, $P = 0.034$). This may indicate that there is an impact on animal welfare by using this device that is not justified by improved behaviour in untrained horses. However, IRT readings of core temperature ($T = 0.08$, $N = 13$, $P = 0.186$) and discrepancy between the eyes ($V = 46$, $N = 13$, $P = 0.972$) did not indicate the Dually® increased stress in subjects. Further studies should determine the pressures the device applies and whether it is more effective than a standard head collar on horses trained to step forward in a Dually. Additional stress measures are needed to assess conflicting results between HGS and IRT.

Lay person message: Since horses weigh so much more than their handlers and have strong flight responses, many people resort to devices to improve their horse's behaviour. A Dually® head collar increases pressure on the horse's head to improve behaviour but our results indicate it isn't more effective than a standard head collar, at least in horses that have not been trained in a Dually previously. This device caused increased grimaces in horses' facial expressions, indicating that it causes them discomfort. We discuss whether this is justified if the device doesn't improve behaviour and talk about further research on horses trained previously in a Dually®.

Keywords: infrared thermography; handling; Horse Grimace Scale; Dually.

The effects of two training methods on rein tension, the head and neck position on the horse, conflict behaviours and judging in collected walk

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Collection is the goal of dressage training, however there is limited information on how this collection is trained. The aim of the study was to compare combined positive (food) / negative reinforcement with only negative reinforcement as training methods on collected walk in 20 Finnhorses. The effects of the two training methods were assessed by measuring rein tension, horse posture (from each video recording similar phase was modified into still-picture to measure the angle from croup to withers), conflict behaviours and judging marks. The subjects were ridden collected walk before training by experienced riders and observed to establish a baseline and the same routine was repeated after the training. Each subject participated in a training protocol during which they were taught to achieve and maintain collected position with a simple cue of the rider; lifting both reins upwards. Half of the subjects were trained utilizing shaping and negative reinforcement (n = 10) and half of the subjects were trained using shaping and combined reinforcement (n = 10). Each horse was trained ten to twelve sessions (total amount of 60...70 repetitions). No significant difference was observed in rein tension between baseline and post-training (average rein tension all subjects; P = 0.837, Wilcoxon signed rank test, W = 99.0). Significant increase in croup-withers angle post-training indicated increased self-carriage and uphill way of moving compared with baseline measures in all subjects (P = 0.002, Paired t-test t19=-3.49, 95% CI, -3.245; -0.812). There was a significant reduction in conflict behaviour frequency in all subjects, irrespective of treatment group, post-training compared to the pre-training baseline (P = 0.024, Wilcoxon signed rank test, W = 30). Judge marks did not correlate with training method, rein tension, the position of the horse or with the amount of conflict behaviours. The results of the study suggest collection can be trained as an operant response using either negative reinforcement or combined reinforcement. The results of the study also suggest since there was significant increase in croup-wither angles post-training indicating increased uphill way of moving and self-carriage without increase in rein tension required, and significant decrease in conflict behaviours post-training, it is possible the subjects represented more features linked to collection with less stress post-training. This finding may have welfare implications in dressage training, as the use of conflicting aids or relentless pressure via reins is not supported. Training horses according to the concept of the "happy athlete" may require correct utilization of operant conditioning techniques in the equestrian sport of dressage.

Lay person message: There is limited information on how collection is trained in dressage horses. A simple cue for collection was trained and tested. The results of the study suggest collection can be trained as an operant response. Since there was a significant increase in croup-wither angles post-training indicating increased uphill way of moving and self-carriage without increase in rein tension required, and significant decrease in conflict behaviours post-training, it is likely the subjects could achieve greater collection with less stress experienced. This finding may have welfare implications in dressage training, as the use of conflicting aids or relentless pressure via reins is not supported.

Keywords: dressage; collection; positive reinforcement; repeat reinforcement; food reward; welfare.

Investigating pressure absorbency using a novel saddle pad with optional insert compared to a common cotton saddle pad used in the equine industry

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In UK, 5.5% of health issues are attributed to back problems with 26% showing associated lameness. The effects of poor saddle fit may negatively impact welfare and inhibit performance in athletic horses due to pressure related pathologies. Studies found that 87.5% of riders use a saddle pad to increase comfort for the horse. A saddle pad with claims of up to 90% energy absorption between horse and rider, when used with specialized inserts, was used in this study. The aim of this study was to investigate the saddle pressure exerted on the horse's back using the saddle pad on its own, and with its two inserts; one made of urethane foam (UF), and one made of a combination of urethane foam and memory foam (UM). These were compared to a cotton saddle pad (control). Nine riders (mean ± SEM; weight 74.2 kg ± 1.12; height 169.3 cm ± 0.72) undertook a randomised controlled trial on a mechanical horse using a dressage saddle. Pressure under saddle was measured recorded using a Tekscan CONFORMat for 10 seconds/20fps in walk, trot and canter for each treatment (saddle pad only, with UF, with UM inserts, and control) with each gait repeated three times. Peak pressure under saddle was compared between groups using Kruskal-Wallis and Mann-Whitney U tests. Results showed a significant decrease in saddle pressure when using the saddle pad alone or with UF or UM in walk (UF: $U = 3$, $Z = -6.254$; UM: $U = 34$, $Z = -5.718$), trot (UF: $U = .000$, $Z = -6.306$; UM: $U = 65$, $Z = -5.183$) and canter (UF: $U = .000$, $Z = -6.308$; UM: $U = 13.5$, $Z = -6.074$), when compared with the control ($F_{3,104} = 80.384$; $p < 0.001$). There was a significant decrease in pressure with the UM inserts and the UF inserts, compared to the saddle pad on its own ($U = 13$, $Z = -6.081$; $U = 19$, $Z = 5.987$; $U = 9$, $Z = -6.150$; $U = 54.5$, $Z = 5.363$; $p < 0.001$). No difference was observed between saddle pad on its own, and with the UF inserts in walk and canter ($U = 283.5$, $Z = -1.401$; $p = 1.61$; $P = 1.000$). Although the data suggest pressure is reduced using the UF inserts when compared with the control pad, they were higher than the pressures of the saddle pad on its own, contrary to manufacturer suggestions. As there is no previous research in this area at the current time, industry comparisons cannot be made. It can however be concluded that the treatments used in this study significantly reduced the peak pressures under the saddle and may improve equine welfare and potentially reduce factors inhibiting performance.

Lay person message: Optimal saddle fit to reduce pressure and associated back pain has shown to improve performance in leisure and competition horses. Nine riders were assessed with a pressure measuring mat on a mechanical horse to determine pressures under the saddle using 4 different saddle pads. It was found there is a significant difference between pads. It was concluded a reduction in pressure may improve performance and welfare.

Keywords: equine; welfare; performance; pressure; saddle-pad; horse.

In honour of Caprilli: the 'father' of modern equestrian jumping technique

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Federico Caprilli's innovation of the "forward" jumping seat changed the equestrian world. In the traditional, "backward" seat, riders were braced against long stirrups with their feet pushed forward, leaning back and relying on heavy rein contact for their stability. Their horses jumped with hollowed backs, enduring severe pressure on their mouths while quite unable to adjust their vision, effectively jumping 'blind'. They were athletically impeded, often hitting their fences, and their ability to absorb the immense impact of landing was seriously compromised. Alas, this style displayed a lamentable lack of understanding of the horse's biomechanics and physiology, contributing too many falls and generally limiting most riders to jumping single fences of modest size. By contrast, and in response to careful observation of the natural flight of horses over a fence, Caprilli radically shortened the riders' stirrups, closed the angles of their hips, knees, ankles and elbows, and brought their lower legs back to promote security. This, in conjunction with a forward-leaning body, re-aligned their centre of gravity with that of their horse. The horse's head was freed so it could adjust its focal length, assess the demands of the fence, judge its points of take-off and landing, and jump with gymnastic integrity. Pre-Caprilli photographs of the time, show that jumping was a dangerous activity for the rider and a distressing experience for the horse. Use of the backward seat commonly resulted in concussive injuries, spinal degeneration and sacro-iliac displacements which negatively impinged on a horse's long-term soundness. It is clear that Caprilli brought relief to what, in today's terms, would have been viewed as significant welfare issues for the jumping horse. Following the inclusion of equestrian sports in the 1912 Olympics, the growing popularity of show jumping spawned a need for a safer technique which delivered more reliable results. Caprilli's forward seat was soon widely adopted with great success. He also adjusted the rider's head position, which, by increasing their field of vision, was also critical to safely addressing the complexities of the emergent show jumping courses. Caprilli's work is no less relevant today as our competition courses become ever bigger and more demanding. The forward seat is now universally used at all levels, across all jumping disciplines. The equestrian community is proud to honour Caprilli's legacy, and to perpetuate his teachings in the interests of upholding riders' safety and conserving the soundness and wellbeing of all jumping horses.

Lay person message: Federico Caprilli entirely changed how riders rode over fences. In doing so, he immeasurably increased the safety of horse and rider and improved the soundness and wellbeing of jumping horses. This presentation explains how and why Caprilli's influence has been so profound and contributed so greatly to the development of equestrian jumping disciplines as we now know them. With the future demands of equestrian sport in mind, it honours Caprilli's memory and entrusts his work to the coaches and riders of today, in the best interests of the jumping horses of tomorrow.

Keywords: Caprilli; jumping technique; safety; soundness; welfare.

Heart rate responses to training and handling activities in horses

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A range of handling, riding and husbandry procedures result in signs of behavioural and/or physiological stress in horses. Exposure to stress may be positive or negative depending on the stressor and the cost and outcome of coping. We analysed 23 studies which reported stress responses of horses to three common types of training conditions: foundation training of naïve horses (F, *n*= 9), exposure to novel objects/stimuli or contexts (E, *n* = 7) and retraining/training of experienced horses (T, *n* = 7). Signs of stress system activation in horses undergoing handling or training such as increases in heart rate (HR) and glucocorticoid levels (GC), are commonly viewed as indicative of welfare compromise. However, research in other species suggests that moderate elevations in stress responsive neurotransmitters such as noradrenaline which also increases HR and GC improve learning. This review focussed on reported HR responses. Mean HR for F horses was the highest at 83.81 ± 23.73 bpm with a mean peak of 113.87 ± 36.85 bpm. T horses exhibited mean HRs of 77.91 ± 31.76 bpm and mean peak 110.18 ± 27.62 bpm. E horses exhibited a mean HR of 71.95 ± 23.53 bpm and mean peak of 83.58 ± 24.28 bpm. Further analysis was undertaken on studies that included at least one treatment and a control. All groups resulted in a significant increase in mean heart rate compared to controls (87 ± 5.5 and 51 ± 1.5 respectively, one-sample $t = 7.1$, $df = 31$, $P < 0.0001$). Pairwise comparisons indicated that the mean heart rate of group E increased significantly more than the mean heart rate of group T (T-test $t = 3.3$, $df = 24$, $P < 0.01$). These results suggest that prior exposure to controllable stress during earlier training in the T group horses may have attenuated their stress responses to the treatment stressor, mirroring the findings of the rodent literature. Uncontrollable stressors from which animals cannot escape are the most detrimental to welfare, whereas controllable stressors which the animal can learn to escape or avoid can be adaptive, leading to enhanced learning and improved stress resilience. Training methods that gain control of horse behaviour may be perceived as controllable or uncontrollable by the horse, depending on how successfully the horse learns to escape or avoid aversive stimuli. The dose effects of stress-related neurotransmitters on equine learning are unknown and further research could identify the levels at which training related increases in stress biochemistry shift from enhancing to impairing learning.

Lay person message: Many handling and training activities are stressful for horses. If the stress is uncontrollable, the horse's capacity for learning may be impaired. Research has showed that heart rates of horses undergoing foundation training were higher than those encountering novel stimuli or learning a new behaviour. Experienced horses undergoing further training or exposed to novel stimuli had lower heart rates. This suggests that the experience of controllable stress in previous training helped the experienced horses cope with stress better and confirms the importance of ensuring that training methods allow horses to learn how control their exposure to stress during training.

Keywords: learning; stress; heart rate; foundation training; equine; welfare.

How does rider awareness affect asymmetrical rein tension whilst riding?

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A comprehensive understanding of horse-human interaction is needed to facilitate good equine training, performance and welfare. Riders are often told that they must 'feel' and 'achieve contact', yet these goals are rarely objectively quantified resulting in inconsistent use of signals. Asymmetric application of rein tension can result in the horse becoming confused and consequently experiencing reduced welfare. This study aimed to determine the effect of receiving feedback on the symmetry of riders rein use. Fourteen horse-rider dyads were randomly allocated to either Control (n = 7, did not receive feedback regarding symmetry) or Experimental condition (n = 7, received symmetry feedback). All horses were fitted with a Centaur Rein Tension Gauge. Rein tension data (100 Hz) were synchronised with video (50 Hz) using a custom made solenoid and LED device. In Phase 1 all horse-rider dyads trotted (always rising or sitting depending on rider preference) down a centre line in an indoor arena for 16 strides in both directions, ten times, and did not receive any feedback on rein use symmetry. On completing Phase 1, Experimental dyads received feedback regarding the observed symmetry/asymmetry whilst Control dyads did not. All dyads completed another ten centre lines for 16 strides in both directions in trot in Phase 2. On completing Phase 2 all riders reported how they subjectively 'felt' regarding their rein tension symmetry. Left and right rein tension data were used to calculate a Laterality Index (LI) as an indicator of symmetry. There were no differences in LI between Control and Experimental groups in Phase 1 ($V = 1421$; $P > 0.05$; Control: mean LI = 1.65; Experimental: mean LI = -4.58) indicating equivalent baseline rein symmetry before the experimental phase (Phase 2) commenced. No significant differences were found for the Control group where no symmetry-related feedback was provided between Phase 1 and Phase 2 ($V = 1345$; $P > 0.05$; Phase 1: mean LI = 1.65; Phase 2: mean LI =-1.35). Similarly no significant differences were found between Phases 1 and 2 for the Experimental group where riders were provided with symmetry-related feedback prior to commencing Phase 2 ($V = 1131$; $P > 0.05$; Phase 1: mean LI = -4.58; Phase 2; mean LI =-3.20). Analysis of objectively LIs indicates that providing riders with feedback regarding their rein tension symmetry has no effect on their subsequently applied rein tension. However, subjectively riders reported that receiving feedback made them more aware of their rein tension symmetries. Understanding rein tension symmetry/asymmetry could lead to improved application of rein aids and ultimately benefit horse welfare.

Lay person message: Riders use reins to guide the horse's movement and direction. Consistency in the information given to the horse is critical to effective equine training, performance and welfare. Although riders often seek feedback on their riding from someone on the ground, in this study providing feedback on rein symmetry did not result in any observable changes in rein symmetry. However, riders did report being more aware of what they were doing with their hands after receiving feedback. Understanding rein tension symmetry could have significant effect on how riders apply their rein aids and ultimately benefit the horse's welfare.

Keywords: rein tension; symmetry; equine; equitation science; training, welfare.

A preliminary investigation of the measurement of stirrup force asymmetry in horse riders

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Asymmetry is very common in humans. It is implicated as a cause of back pain in both the human and equine athlete. New technologies, such as electronic saddle pads and suits, have been proposed to quantify asymmetry in riders and influence saddle fitting to reduce back pain in horses. In a recent study, more than 80% of the riders showed asymmetrical hip rotation. The aims of this study were to document asymmetry in riders using load cells applied on the stirrups and to identify possible associations between rider asymmetry and his/her age, sex, handedness, riding experience and level, equestrian style and type of sport. Data were collected from 148 riders. Each rider completed an information survey and performed a standardized test on a saddle fixed on a wooden horseback shape. The test was split into three phases of 1 minute each: 1) sit on the saddle, 2) standing up on the stirrups, 3) simulated rising trot. The equipment recorded the force on the left and right stirrup every 0.2 sec. A paired t-test was performed on the recorded data to test difference (i.e. asymmetry) in each of the phases. In phase 1, 2 and 3, 99.3% (53.4% heavier on the right (R)), 98% (52.8% heavier on the left (L)) and 46.3% (51.5% heavier on L) of the riders were asymmetrical. Chi-square tests showed no significant association between handedness (L, R) and leg sidedness (L, R) (all $P>0.05$). Univariate logistic (1: asymmetry, 0: symmetry) regression analysis was performed on phase 3 data using the following predictive variables: rider's age, sex, experience (<5, 6-10, 11-15, 16-20, 21> years), handedness, level (beginner, intermediate, advanced and professional), involvement in a competitive sport (yes, no), riding style (one hand, two hands). Only riding style was associated with asymmetry. One hand style horse riders were found twice more likely to be asymmetrical than two hand style riders (OR: 2.18, CI: 1.1-4.29; $P = 0.024$) during simulated rising trot on a fixed saddle. A tendency was also found with sex; men were more likely to be asymmetrical than women (OR: 1.86, CI: 0.96-3.58; $P = 0.064$). This study confirms that the majority of the horse riders are asymmetrical while sitting on the saddle or standing up on the stirrups. Some riders were able to balance evenly during simulated rising trot, but the one hand riding style riders were more likely to be asymmetrical.

Lay person message: Asymmetry is common in human, but it may lead to back pain in the ridden horses. New technologies are available to test balance ability of horse riders. During this pilot study we recorded how much weight riders were able to distribute on the left and right stirrup while sitting, standing and trotting on a fixed saddle. The one hand riding style riders were more asymmetrical and this may be a risk factor of back pain in horses.

Keywords: asymmetry; horse; riding style; stirrup.

Ten principles of learning theory in equitation: a practitioner's translation of the ISES approach

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The goal of International Society for Equitation Science is to create a sustainable anthropo-equine relationship by spreading the 10 ISES principles. However, most of today's riding teachers are still in need of innovative tools to explain these academic principles to novice riders, in order to enhance every day equitation and improve the welfare of both riding school horses and their riders. In this project we have modernised and updated the equitation educational curriculum. Sixteen online manuals, approximately 3500 pages, containing all the information needed by the Dutch qualification files for equitation instructors and relevant sectoral guidelines (ethology, welfare, safety) were reviewed. There was an urgent need to develop a pliable, transparent set of attractive and reliable tools for practitioners/instructors to teach specifically negative reinforcement (NR) to (young) novice riders. Throughout the new approach tools were developed to transform the 10 ISES principles towards 10 points for the Wellbeing-of-Working horses (WOW). WOW guides practitioners and their pupils in an attractive way to understand the horses' perspective and to enhance the communication between horse and rider. WOW is a mentored practitioners project and will be part of a future research project. WOW explains the theory behind horse/horse, and horse/rider communication to novice level. It simplifies this communication by using expressive cartoons and 10 exclamations to describe horse and human behaviour: YES; NO; HEY; OOPS; UH?; TILT; CHILL; AHA; AUCH; WOW! The method also included 10 practical exercises for riders to train the correct application of negative reinforcement while also implementing the horses' needs and cognition as laid out by ISES. These 10 exercises were developed to be self-correcting and teach riders to ride 'on reward': rewarding the shaping process, while omitting repetitive aids. Ultimately, the novice and/or young riders are guided to perform the exercises one after the other, creating a customised 30-minute warmingup program for daily workouts. During the warming-up riders are repeating the basic aids and recognise responses on a daily basis, forming consistent habits for both (riding school) horse and rider. WOW riders are probably not able to explain how NR works in academic terms, but they can explain and apply it consistently during various situations. They learn to walk 'aids free, without dash or delay', 'halt without hands' or use '123Thanks'. The presentation will include several videos showing how the academic approach, after translation, gave riders pragmatic tools to incorporate the ISES principles in their own riding.

Lay person message: Ten points for the Wellbeing Of Working horses (WOW) provides a practitioner's translation of the academic way of sustainable training with expressive illustrations and 10 pragmatic exercises. We need to realise we are still at the very beginning of what might become a bigger movement, though we found answers "yesterday" we still have to bring the ISES message to millions of riders to ensure a future where horses are still part of our lives. It is shown that WOW provides tools to explain the ISES academic approach of good training down to novice level.

Keywords: ISES principles; riding school; practical tools; sustainable instruction; novice riders.

Body acceleration in riders during canter and gallop

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A French study on the health of the professional rider, in 2016, showed high prevalence of back pain for over one month and of chronic pain: 25% and 9% for neck pain, 24% and 13% for thoracic spine pain and 33% and 23% for low back pain. By focusing on back pain, we must consider stress suffered by the spine. The aim of this study was to assess accelerations suffered by the rider's back at canter and gallop. Three eventing horse/rider pairs (international level) and three dressage pairs (grand prix level) were equipped with three inertial sensors (APDM, USA). They were located at the 5th lumbar vertebra (L5), the sternum of the rider and the sternum of the horse. For 6 strides in a straight line the magnitudes of accelerations were calculated using the root mean square (RMS) of the anteroposterieur acceleration (AP), medio lateral acceleration (ML) and cranio-caudal for the rider and dorsoventral acceleration for the horse (V). The ability to attenuate accelerations through the upper body was quantified with a shock absorption coefficient. It describes the ability to reduce acceleration from horse to rider's L5 (CoeffH/L5 = (1- rmsL5/rmsH)*100) and from rider's L5 to rider's sternum cavalier (CoeffL5/ST = (1- rmsST/rmsL5)*100). A Kruskal-Wallis test was used to assess the difference between variables at gallop and canter. Statistical significance was set at $P < 0.05$. Dressage and cross-country riding were different from AP and ML accelerations at L5, higher for cross country riders (rms AP: 7±1 m/s² vs 3±0.5 m/s², 0.003; rms ML: 3.5±0.5 vs 2±0.5 m/s², P = 0.006) and V accelerations at sternum, higher for dressage riders (14±1 vs 11±0.5 m/s², P = 0.004). The shock absorption coefficient (Coeff H/L5) was different (p=0.004; cross-country rider: 11±6.5 % vs dressage rider: -19±3 %). The dressage riders increased craniocaudal accelerations, while the cross-country rider dampened them. V accelerations produced by dressage riders were weakly softened by the upper body, unlike the cross-country riders, standing and balancing on stirrups (CoeffL5/ST: 18±7 % vs; 4.5±4 %; P = 0.006). Mean peak V accelerations at L5 were not different between the two types of gallop. The rider received a peak (35±6 m/s²) per stride (1.75 Hz). These values are below the acceptable limits published in the literature with regard to the physical integrity of the spine. However a good coordination between horse and rider, the accuracy of the movement (symmetrical balance of the cross-country rider, verticality of the dressage rider's back), the stability, acquired by the core training, were essential to minimize joint loads.

Lay person message: A harmonious play of the muscular groups influence the management of the forces transmitted by the horse at each stride. For the cross-country rider, the lower limbs and flex trunk cushion the accelerations. For the dressage rider, it is the lumbar region that manages the forces. The verticality of the dressage rider's trunk with the respect of curves is essential for the integrity of the spine.

Keywords: rider; back; acceleration; health; dressage; cross-country.

Impact of gait, rider, and horse on rein tension and sturrup forces: a preliminary study

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The performance in riding includes factors related to the rider, the horse, the equipment and their interrelationship. When there is a fault, coaches can point out rider aids, while rider blames the horse. The ability to vary the intensity of legs and hands actions is a challenge for the rider. Studies have described reins tension in different conditions (gaits, figures, hands, riders' level, laterality, equipment) and pressures on stirrups have been described at sitting and rising trot. To our knowledge, no study assessed simultaneously the forces in the reins and in the stirrups. In the light of the literature, we hypothesized that rein tensions and stirrups forces reflect general gait kinematics, but are also determined by horse and rider effects. The aim of this study was to clarify the hierarchialization of the riding performance factors. An embedded tool was custom-made designed. It consists in four synchronised monoaxial force sensors (reins and stirrups). Normal forces on stirrups and tension of reins were recorded at 900 Hz. Horses were equipped with the personal saddle of the rider, bridle with a snaffle bit. Video recordings were made of the riding session. Data were collected from 2 professional riders with 3 horses (grand prix level).The six recording sessions were made under the same conditions. After the warm up, they performed trot and canter on straight line at both hands. For six strides on a straight line at rising trot and canter, root mean square (RMS) and mean peak force (MPF) were computed for the right stirrup (RS), for the left stirrup (LS), for the right rein (RR), and for the left rein (LR). The first results with these two riders and three horses showed trends: reins tensions were highest in canter (canter MFP RR 26±11 N and MFP LR 35±15 N vs trot MFP RR=15±6 N and MFP LR=26±15N) and forces on stirrups were highest in trot (trot MFP RS 695±94 N and MFP LS=732±104 N vs canter MFP RS 229±84 N and MFP LS=222±79 N). Riders distinguished themselves by values of left rein tensions (cav1 MFP RG 39±14 N vs cav2 25±13 N). This could be explained by the laterality of the rider with a sensory-motor asymmetry more marked in one of right-handed rider. Moreover, rein tensions and stirrup forces were equal whatever the horse. These preliminary results help to hierarchize factors of performance and go into the knowledge of variability of aids.

Lay person message: Forces on stirrups and rein tension are impacted by the gait: rein tensions were highest in canter whereas forces on stirrups were highest in trot. The rider also has a role on rein tensions and stirrups forces. They depend on his ability to vary them. However, this preliminary study does not show differences of rein tensions and stirrup forces values between the three horses.

Keywords: stirrup; rein; force; performance factors, horse, welfare.

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Investigating the accuracy of commercially available rein tension gauges

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There has been increasing interest in rein tension measurement over the last decade, both within academic research and in the wider equine industry. This has led to the development of several commercially available rein tension gauges, marketed at riders, trainers and coaches. This study aimed to test the accuracy of one of these devices against a validated strain gauge system. One 15 year old 16hh riding school gelding ridden in snaffle bridle was selected from a sample in a previous trial due to having a quiet disposition and being consistent in the contact. One 18 year old female British Horse Society Stage 2 rider was used, who was also selected for the ability to maintain a consistent and quiet rein contact. Both horse and rider were previously acclimatised to all equipment used. A commercially available rein tension gauge (COM) was fitted between the bit and the reins and calibrated according to the manufacturer's instructions. COM recorded at 10Hz and then provided a mean rein tension every second. Reins containing research validated SMA mini S-Beam force gauges (RES) recording at 100Hz were then attached and calibrated. After a warm up period, horse and rider completed 60 seconds of trot and 30 seconds of canter, during which readings were taken from both rein tension gauges simultaneously. Data were nonparametric and due to the inability to exactly synchronise the recordings and therefore pair the readings, the Mann Whitney U test was used to compare data for each rein within each pace. Significantly higher rein tensions were shown in RES than COM for both left rein ($U = 138224$, $df = 6058$, $P = 0.002$) and right rein ($U = 152350$, $df = 6058$, $P = 0.040$) in the trot. No significant differences were seen in the canter ($P > 0.05$). Discrete Fourier transformation was used to calculate a frequency spectrum of the rein tension data and showed the dominant frequency of rein tension in the trot to be at 2.6Hz. The average trot stride of a riding school type horse is 0.7 seconds in duration, with two rein tension peaks per stride associated with forelimb ground contact, one every 0.35 seconds, which are potentially missed by the COM gauge. Whilst this is only based on one horse-rider combination, it does indicate that commercially available rein tension gauges may not have the recording accuracy to identify small variations in rein tension and as such may provide misleading information to industry professionals, ultimately negatively impacting equine welfare.

Lay person message: The use of rein tension gauges as a training tool is gaining in popularity; however the recording speed of some commercially available devices is too slow to identify the regular peaks in rein tension seen with the horse's stride. This would make rein tension readings appear lower than they actually are, possibly compromising horse welfare as riders would not be alerted to higher rein tensions. Users should be advised to choose a rein tension gauge which records 100 measurements per second or more.

Keywords: Rein tension; training; coaching; equitation; equine; welfare.

The impact of a dressage simulator based training programme on rider position

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The use of riding simulators for training is increasing in popularity and is a valuable tool for training of riders without compromising horse welfare. This study aimed to assess the impact of a simulator based training programme on rider kinematics. A group of 12 female riders were fitted with joint markers at the centre of the coxofemoral, femorotibial, tibiotarsal, glenohumeral and humeroradial joints on the lateral view, on the boot over the fifth phalange, and on the hat, above the ear. Riders were video recorded at 500Hz from both left and right for three stride cycles of sitting trot on their own horse. Quintic Biomechanics v29 was used to measure the upper arm inclination, lower limb joint angles and the deviation of both the upper body (hip to ear) and lower body (hip to ankle) from the vertical and a mean taken. Seven riders completed a sixweek training programme using the 'Rider Symmetry' method, which consists of exercises developed to improve function of the hip musculature, conducted on the Racewood dressage simulator. Training sessions were delivered by a British Horse Society qualified coach, trained in the 'Rider Symmetry' method, and exercises were tailored to individual rider's needs. Five riders remained untrained as a control group and all riders underwent the same kinematic assessment at the end of the training period. Data for left and right views were combined and the paired t-test was used to compare pre and post training measurements for each group. Asymmetry was calculated for each variable as the difference between left and right measurements and the Wilcoxon signed rank test was used to compare pre and post training. The trained group showed a significant increase in coxofemoral angle ($t = -2.507$, $df = 13$, $P = 0.026$) and a significant decrease in coxofemoral asymmetry ($Z = -2.366$, $df = 6$, $P = 0.018$) after the training programme. No significant differences were seen in any other measures ($P > 0.05$) and no differences were seen in the control group ($P > 0.05$). These results demonstrate that a targeted training programme on the riding simulator is useful for increasing rider hip angle and symmetry. Previous studies have shown an increase in hip angle in riders of a higher ability and link this with increased effectiveness in leg aid application. Improvement in symmetry is of benefit to the horse as well as the rider; future studies could consider the impact of such training on pressure distribution between horse and rider.

Lay person message: Training on riding simulators is becoming more commonplace with a number of centres offering this facility. This study shows that the 'Rider Symmetry' method, which consists of exercises targeted at the hip area conducted on the riding simulator, is effective at improving rider leg position and does help to make the rider more symmetrical. This can help to improve symmetry of the rider's seat and aid application, leading to better communication with the horse and ultimately better training.

Keywords: training; biomechanics; rider posture; dressage; simulator.

Exploring relationship among conformation, kinematics, and acceleration measured at the position of the horse's back

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The physical benefits derived by human participants of therapeutic riding and hippotherapy result from the movement transmitted from horse to rider. The relationship between conformation, stride characteristics, and acceleration measured at the position of the back is poorly understood warranting investigation. We hypothesized that straighter angles in the forelimb would increase acceleration in the dorsoventral plane, and a longer stride length would increase acceleration in the anterior/posterior and mediolateral planes. Length and height measurements (in-field measurements by a trained experimenter using a tape measure) of four horses were recorded. Flat retroreflective markers were placed on key anatomical landmarks and horses were photographed for subsequent analysis of joint angles (Dartfish, software for manual kinematic data reduction). Horses were fitted with an accelerometer attached to the seat of a saddle. Threedimensional (mediolateral, anterior/posterior, dorsoventral) acceleration data and video were recorded during 5 walk and trot strides. Stride length, tracking distance, stance width, and time spent in unipedal, bipedal, and tripedal support and suspension were determined using Dartfish. Stepwise regression was used to select significant conformation and kinematic variables related to acceleration (calculated as the difference between maximum and minimum). More time spent in tripedal support (mean = 64.2 % of stride) increased (F value = 145.70, d.f. = 2, P = 0.0068) dorsoventral acceleration at the walk (mean = 4.10 m/s^2). Greater mediolateral acceleration at the walk (mean = 9.87 m/s^2) was related to a greater fore fetlock angle (mean = 142°) and longer leg length (mean = 85 cm) (F value = 58607.5, d.f. = 1, P = 0.0029). Greater fore fetlock angle (mean = 142°) and height at the hip (mean = 152 cm) increased (F value = 3359.17, d.f. = 1, P = 0.0122) dorsoventral acceleration at the trot (mean = 26.7 m/s^2). Greater mediolateral acceleration at the trot (mean = 12.0 m/s^2) was related to greater height at the withers (mean = 148 cm) and a smaller femur inclination (mean = 62.9°) (F value = 1593.67, d.f. = 1, P = 0.0177). Results indicate select conformational and kinematic variables are predictive of acceleration at the position of the back making such variables useful tools in selecting horses. Further work is needed to establish if acceleration at the position of the back is indicative of the movement transmitted to the rider.

Lay person message: Movement transmitted from horse to human participant is central to the effectiveness of therapeutic riding and hippotherapy, making it an important selection criterion for horses. Relationships between select angle, body measurement, and stride characteristic variables were observed to influence acceleration measured at the position of the horse's back. Results suggest easily measured variables are useful in predicting acceleration measured at the position of the back providing a possible horse selection tool. Current findings and future work in this area will contribute to program effectiveness and also may have implications for monitoring soundness of horses in equine assisted activities and therapies.

Keywords: conformation; gait; kinematics; selection; acceleration.

Noseband tightness on National German leisure competion in low and medium classes

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In national as well as in international competitions, it is obligatory in to wear a noseband. The correct fit of these elements is a matter of debate. The aim of this study was to evaluate the present situation in Germany. Our hypothesis was based on recent findings, that in leisure competitions the majority of nosebands are adjusted too tight. In small, national leisure competitions, the nosebands of 221 horses (jumping and dressage) were measured with the ISES taper gauge therefore scaled with more than 2; 2; 1.5; 1; 0.5 and 0 fingers width between the noseband and the frontal nasal bone. For the statistical calculations, a Chi-Squared-Test was used. Significant data were determined at $p<0.05$. The mean age of the riders was 29.6 +/- 11.2 years. Their mean experience with competitions as 15.3 +/- 10.3 years. 201 riders were female, 20 were male. The horses were aged in average 9 +/- 3.6 years. 148 geldings, 9 stallions and 73 mares were included. Among 221 measurements, 3.68% of the nosebands were tightened at 0 fingers and 1.81% at 1 finger. 19.46% were fastened at 1.5 finger and 43.89% at 2 finger level. 25.79% exceeded the 2-finger level. Results indicate that significantly more nosebands (69.86%, $P < 0.01$) were tightened according to the rules in 2017 than in other studies from 2016. 30.32 % were fastened tighter than the 2-finger level. The following factors (discipline, level of the class, age of rider and horse, operation experience with competitions of rider, noseband type and marks for the tests) were also analyzed. The only difference occurred between the disciplines- the dressage riders ($n = 145$) had their nosebands significantly (36.5 %, $P < 0.01$) tighter than the jumpers (18.42%, $n = 75$). These data contain no information regarding the noseband fit on elite competitions, so more observational research is needed at this point to gain an assessment on general noseband fit in other riding groups. In general, most leisure riders in Germany seem to be aware of the welfare implications for tight nosebands and of the suitable fit of the headgear, but still nearly one third of the nosebands are too tight.

Lay person message: Correct noseband fit is an important issue for horse welfare. In Germany in small leisure competitions, the nosebands were fastened according to the rules in most of of cases. This means 2- fingers space or more between nasal bone and noseband. However, 30-32% of the nosebands were still too tight. The dressage riders had their nosebands adjusted significantly tighter than the jumpers. Thus, there is need for further action regarding the knowledge of correct, horse friendly fit of nosebands.

Keywords: noseband; ISES taper gauge; 2-finger-rule; riding; competition; dressage

The importance of Thoroughbred blood in four–star event horses

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The Thoroughbred is an athletic animal that is built for speed and stamina and often used to breed event horses. The aim of this study was to determine an effect of Thoroughbred blood levels in event horses on the performance at four-star competition using global breeding and eventing data. There is a lack of research investigating the impact of pedigree on performance in eventing, including four-star level and in particular, the Thoroughbred. This research may be used to reduce wastage in the eventing discipline. At four-star level, the horse-rider combination must achieve the lowest score to win the competition. Data were collected on Thoroughbred blood percentage and four-star competition scores from 2012 to 2017 from all four-star competitions. A total record of 1195 four-star event horses TB blood percentage and scores were collected to determine associations and differences between these traits. Competition scores included dressage, cross-country, showjumping and total scores. There were a total of 56 missing TB blood records that were not included in the TB blood statistical analysis. There was a weak, negative correlation between percentage TB and position, which was statistically significant (n = 1137, rs = -.116, P = 0.0005). A weak, negative correlation between percentage TB and cross-country score was found to be statistically significant, n = 1137, rs = -.157, p = .0005. There was a significant difference between the different four-star competitions and percentage Thoroughbred ($\chi^2(5) = 44.984$, P = 0.0005). In the top 10 placings, a weak, negative correlation between Thoroughbred blood percentage and position was found, n= 341, rs = -.118, P = .029. This study found that the amount of Thoroughbred blood affects performance at four-star level of eventing. This effect is that as the level of Thoroughbred blood increases, the better position the horse will place. However, purebred Thoroughbreds do not perform well at four-star level. This does not suggest that these horses cannot succeed in the lower levels of eventing. The low level of correlation found suggests another factor may have greater influence, such as management, training and going of the surface. Also, the level of Thoroughbred has an influence on the cross-country scoring, not dressage or show jumping.

Lay person message: Breeding is an important factor for good performance in eventing, especially at the four-star level, and can lead to wastage. Many have preferred breeds to create a competitive eventing horse with no evidence to support this, including the Thoroughbred. Competition results and percentage of Thoroughbred blood of 1195 four-star event horses were collected for analysis. It was found that horses with high levels of Thoroughbred perform better than others. However, purebred Thoroughbreds did not perform well. This research may be used to reduce wastage as well as to improve training and welfare of event horses.

Keywords: Thoroughbred; eventing; four-star; breeding; performance; wastage.

Relationship between measures of symmetry (laterality, rein tension parameters, injuries, harmony of riders) and horses' muscle trigger point reactions

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Muscular symmetry and health is considered to influence equine performance and laterality during riding. However muscular trigger point (TP, irritable spots in the fascia surrounding skeletal muscles) reactions have not been investigated in this context. The study investigated the relationship between various parameters related to equine symmetry (rein tension laterality, earlier musculoskeletal injury and harmony of rides as reported by owners and the lateral displacement of the hindquarters) and horses' TP reactions. Mean, SD and mean left-right difference (quantitative symmetry) of rein tension were measured in 65 riders (49=right-handed, 14=left-handed, 2=ambidextrous) and 88 horses (47=male, 41=female, aged 3-25 years) in walk, trot, canter and gait transitions in both directions (n=106 rides). Additionally, 28 TPs commonly treated in equine physiotherapy were assessed bilaterally according to the reaction to manual pressure as validated in earlier studies (score 0 (no reaction) – 3 (strong avoidance reaction)). The influence of symmetry measures on mean and sum of TP score of each side was assessed using mixed-model analysis (F test throughout). The sum of trigger point reaction (TPR) of the horse's left side ($p=0.038$) was related to harmony of horse-rider communication (i.e. rider's perception of horse's suppleness and stability of rein contact). Horses perceived as tensed (13.8±3) or very unharmonious (20.7±5.5) test rides showed stronger TPR compared to harmonious rides (11.8±1.3) or unharmonious rides (8.5±1.6). Horses carrying their tail either left (13.4±1.6 sum left vs. 17.3±1.8 sum right) or right (8.8±1.5 sum left vs. 10±1.7 sum right) showed stronger TPR on the right body side ($P = 0.01$) only. Previous musculoskeletal injuries were related to stronger TPR on the right side only ($P = 0.047$), especially in horses with bilateral injuries (16.7±1.8) compared to horses with injuries to the left (15.6±3.8) and right side (10.2±1.9). In contrast to common assumptions in the riding literature, the sum and symmetry of TPR was not influenced by laterality of horses as assessed by their riders nor the lateral displacement of their hindquarters, human handedness or any rein tension variables ($P > 0.05$). Instead, muscular balance rather than the absence of muscular tension and active TP seems important for body symmetry and performance. Especially muscles moving the hip and shoulder joint e.g. M. triceps brachii or Mm. glutei related significantly to the sum of reaction level ($r > 0.6$) and mean TPR ($r > 0.5$, all $P < 0.0001$). Considering horse's muscular health appears important for equine welfare and has the potential to add further knowledge to investigations of horse-rider-interactions and horse injuries.

Lay person message: Rein tension did not influence the sum and symmetry of TPR. Asymmetric and strong TPR were found in "very unharmonious" test rides and tails carried to either side rather than straight. Previously injured horses showed stronger TPR on the right. Muscles moving the hip and shoulder joint show stronger TP. TPR was not influenced by laterality during riding or the lateral displacement of horse's hindquarters. Muscular balance rather than the absence of muscular tension and active TP seems important for body symmetry, health and performance. The horse's muscle state should be considered when investigating horse-rider-interactions and horse injuries.

Keywords: rein tension; muscle trigger points; laterality; injury; symmetry.

Influence of age at first training or competition start on health and duration of competition careers in horses: a review and meta–analisis

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The optimal age at training onset and first competition start in horses are subject to contentious debate. While many of those with best intentions for equine welfare call for regulations that set a minimum age for first training and competition starts, there is some evidence that there are advantages for horses having their first starts at younger rather than older ages. Given that even under the best of modern husbandry conditions, the evolutionary destined level of locomotion can hardly be achieved, any means of providing additional exercise to the growing horse can be assumed to be helpful to support development of a sound musculoskeletal system. On the other hand, it is also likely that undue load of sensitive and not fully grown structures cause lasting damage, e.g. if cartilage is not yet fully developed. Therefore, the aim of the present study was to review and analyse the existing scientific literature on the effects of early training and competition starts on health and duration of competitive career of horses. A literature search yielded 21 studies that were categorized into the following groups based on a) study design: epidemiological/population-based (n=15; mostly based on analysis of competition data without specific information on training or husbandry practices) or designed experiment (n=6; specifically investigating factors such as early training in relation to different housing conditions) and b) results: early training/competition harmful, early training/competition contradictory or insignificant effect, early training/competition beneficial to health or length of competitive life. Chi-square statistics showed that overall a significantly larger proportion (71%, $x^2 = 14.0$, $P < 0.05$) of studies pointed to an advantage of an early onset of training or competition for health and duration of competitive career, compared to the proportion of studies showing insignificant or contradictory (19%), or detrimental (10%) effects of early training onset. Advantages of an early competition onset were seen regardless of the type of work or minimum age at first competition start (e.g., race horses: 2 years, dressage and jumping horses: 3 years). However, with the population-based studies, potential confounding due to pre-selection must be kept in mind: the groups of older horses likely contain higher proportions of horses that showed inferior health and/or performance to start with (which may be one of the reasons why they were not shown at the minimum age). Notably, however, also the available studies with a controlled study design show health benefits for some horses trained at a very young age. However, these studies demonstrated that early training must not be judged independent of housing conditions: while horses with pasture-turnout benefit from additional training, the same training is harmful to young horses housed in individual stalls.

Lay person message: A review and meta-analysis of existing studies on the influence of age at training onset and/or first competition start revealed that – in contrast to common belief in practice that early training is harmful to horses' soundness – starting horse-training earlier rather than later is linked to better skeletal health and longer competition careers. However, there is also evidence that only pasture-housed horses benefit from early training, while the same, intensive training in young, stall-housed horses may be harmful to skeletal health. This highlights the importance of providing incentives for continuous locomotion via group housing, pasture-turnout plus additional exercise to young horses.

Keywords: training onset; competition; longevity; health; young horses.

Special Issue: Equine behaviour, health and welfare: Manuscripts from the 14th International Society for Equitation Science Conference

This special issue will welcome the full manuscripts of selected abstracts presented at the 14th Conference of the International Society for Equitation Science. Abstracts presented in the section of good training, good behaviour, good feeding, good housing and good health and mental state will be welcome. The special issues will be contain recent research papers carried out with the aim to safeguard horse health and welfare. Literature reviews which will be useful for all equine industry members from trainers to scientists giving insight on current science-based understanding of how to best handle, train, feed, house and transport domestic horses.

Final manuscript submission deadline: 30/12/2018

"It is therefore essential that the rider let it go and passively accompany the extension movement of its head and neck by bringing his/her hands forward without moving them laterally. The body will be held firm and perpendicularly and the legs, if necessary, will pulsate opportunely and with increasing force, (...) but remember that by doing so, the support must be, as always, very light. (...) the rider will bring the chest proportionally backwards and if the horse goes well, he/she will stop the action of the legs by lowering very much the heels so as to avoid touching the horse with the spurs, and will keep his/her hands firm and low while maintaining a slight support on the mouth."

(Carlo Giubbilei "Federico Caprilli, Life and Writings", p. 85)

Does rider stirrup length affect pressure beneath the saddle during sitting trot?

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One hundred and fifty years after Caprilli the rider-saddle-horse interface and the associated rider's position is still a topic where experienced practitioners have knowledge not yet elucidated by evidencebased science. The pressure experienced by the horse beneath the saddle is a fairly recent area of interest for scientists, with developments in pressure detection tools now enabling empirical investigation. Saddle pressure has been used in both rider position analysis and also studies focusing on the reported negative effects on the horse of ill-distributed pressure. Currently there is little evidence-based information available to coaches on the implications of stirrup length for rider and horse. Greater understanding of the factors affecting saddle pressures will allow for more informed practices. The aim of this study was to compare pressure under the saddle of riders riding at different length stirrups. Eight competent riders (mean weight ±SD = 66 ±5 kg) participated in a quasi-experimental study. A Racewood eventing simulator (to increase internal validity) was fitted with a Tekscan pressure measuring system underneath a general purpose saddle. All riders completed a calibration protocol to ensure the system was adjusted to their body weight and a standardised acclimatisation to the simulator prior to data collection at sitting trot. Data were taken from the riders at a stirrup length level with the *lateral malleolus* first and at longer and shorter stirrup lengths (± mean 3.2 cm, 2 holes), in a cross-over design. The pressure distribution beneath the saddle was recorded for a 30 second sampling period at 12.5 Hz and then analysed using IBM SPSS v24.0 (significance judged using $P<0.05$). There was no statistically significant effect of altering stirrup length on total pressure, maximal sensor pressure or pressure distribution measured ($S=4.839$, 3.263, 2.516 respectively, $df=2$, $P > 0.05$). Total pressure was higher (x2) beneath the cranial third of the saddle, agreeing with literature, but maximal sensor pressures were located beneath the caudal third in a repeated pattern during the gait. At stirrup lengths longer and shorter than the *lateral malleolus* the inter-participant variation reduced. Participants employed riding techniques that resulted in highly variable pressure. This effect was greatest when the stirrup was at *lateral malleolus* level, a suggested indicator of appropriate stirrup length for beginner riders. Further understanding the actual pressures experienced, i.e. with a live horse, and the impact of individual riding techniques would support more evidence-based equestrian coaching and potentially improve horse welfare and rider safety.

Lay person message: Pressure beneath the saddle does not alter reliably between different riders in response to changing stirrup length. When the stirrups are level with the ankle the pressure varies between riders. This variation reduces at longer and shorter stirrup lengths. Pressure beneath the saddle is greatest at the front of the saddle, however points of high pressure are seen during the sitting trot towards the back of the saddle. Greater understanding of stirrup lengths, and the implications of riding technique on pressure on the horse's back is required.

Keywords: pressure; rider; saddle; stirrup; rider position; welfare.

Rider reported factors influencing choice of stirrup length in dressage, showjumping and eventing

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The main functions of a saddle are to improve rider stability and comfort, which improves equine wellbeing by supporting a balanced rider; the stirrups provide support for the rider's legs. The criteria upon which riders base their choice of stirrup-length for different equestrian disciplines does not appear to have been reported. Therefore, this study was designed to investigate the factors that play a role in a rider's choice of stirrup-length for different equestrian sports. An online questionnaire consisting of open and closed demographic questions and 28 Likert scale questions related to factors which influenced stirrup-length was distributed via social media horse pages. Respondents were asked to identify factors that influenced their decision making when setting their stirrup-length in dressage, showjumping and eventing (all phases). A total of 2183 participants answered the survey, the majority were female (97%; n=2131) and classified themselves as amateur riders (91%;n=1983). More participants (n=1200) identified themselves as dressage riders (amateur: 89%, n=1068; professional: 11%, n=132), 665 riders showjumped (amateur: 87%, n=579; professional: 13%,n=86) and a further 393 riders selected eventing as their primary discipline (amateur: 89%, n= 350; professional: 11%,n=43). All riders consistently ranked feel of stirrups once mounted, how stable stirrups feel once moving and type of saddle being used as the three most important factors when deciding stirrup-length across the disciplines. Dressage and showjumping riders considered personal comfort and personal safety the next most important factors. Event riders agreed with their importance when riding cross-country or showjumping but felt riding a new or unfamiliar horse and horse temperament where more important to consider when selecting an appropriate stirrup-length during dressage. Comparison between the disciplines identified dressage riders were more influenced by the factors investigated when setting stirrup-length than either showjumping or event riders (Kruskal Wallis: $P<0.04$). Within eventing respondents, exercise type, safety, saddle selection and rider stability were key factors which influenced stirrup-length selection between the phases of competition. These factors were generally ranked as more important for the dressage / flatwork phase compared to showjumping or cross country schooling (Kruskal Wallis: $P < 0.01$). Stirrup-length is likely to affect rider comfort, performance and safety while having relatively less effect on the horse's well-being, therefore it is not surprising that riders across disciplines placed high emphasis on factors related to the rider and saddle. Further research to understand the impact of stirrup-length on equine wellbeing is required, alongside greater knowledge of rider decision-making to improve rider safety.

Lay person message: Stirrups provide support for rider's legs and can help improve riders' stability in the saddle. The length at which riders choose to set their stirrups during riding will influence these factors. Riders rated which factors they considered most important when deciding stirrup length across dressage, showjumping and eventing. Regardless of discipline, riders rated feel of stirrups once mounted, how stable stirrups felt once moving and the type of saddle being used as the three most important factors when deciding stirrup length. These factors affect rider comfort, performance and stability. Understanding decision-making in riders can improve ridden performance, safety and equine wellbeing.

Keywords: riding; horse; stirrups, rider decision making, safety.

Does training defined by speed zones accurately reflect racehorse workload?

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Despite recent advances in technology, racehorse training remains largely based on anecdotal and traditional practices. Trainers aim to produce horses which are fit and can perform to their best in competition (at the races). Training practices vary between yards but interval training is commonly used, with racehorse workload defined by the speed the horses are exercised at; for example: quarter speed (QS), half speed (HS), three quarter speed (TQS) and full speed (FS). Whether this approach is successful tends to be judged via observational assessment of workload by the trainer and the work rider. This study evaluated if speed zones (SZ) and estimated-workload varied across a 6-week period in the middle of the British National Hunt season, 2017/18. Nine 'race-fit' thoroughbred racehorses (age:8.0±2.3 years) of variable experience (races:14±11) and ability (official rating:103±14) were recruited for the study. Fine EquinityTM heart rate (HR) monitoring systems collected HR and speed data for each horse during all interval training sessions during the study period. Gallop exercise sessions took place on a 4 furlong (805m) allweather gallop. Workload levels were determined by an experienced National Hunt trainer; a typical week's training consisted of D1:2xQS gallops, D2:2xQS & 1xFS gallops, D3:road-work, D4: 3xQS gallops, D5:road-work or 2xHS gallops, D6:2xTQS & 1 FS gallop, D7:horse walker (30minutes). Horses were warmed up prior to galloping (400m) and trotted (350m) then walked (350m) halfway down the gallops between intervals, and after galloping were walked (500m) to cool down. Workload (defined as age-adjusted mean percentage of HR maximum) and speed for each gallop run were recorded and SZ were noted from the trainer. Speed increased incrementally as the SZ progressed: QS:31.17km/h (meanHR:179±17bpm), HS:33.09km/h (meanHR:177±17bpm), TQS:36.55km/h (meanHR:181±20bpm), FS:41.59km/h (meanHR:191±11bpm). Racehorses' actual speed varied as expected between furlongs within SZ (Kruskal Wallis(KW):10, df = 3, $P = 0.0001$) with significant increases recorded between all SZ for F1,2,3 and 4(Mann Whitney U(MWU): $P < 0.01$), except between QS-HS for all furlongs ($P > 0.05$) and TQS-FS for F4 ($P > 0.05$). Interestingly, racehorse workload only varied with SZ for F1 (KW: 9.5, df = 3, $P = 0.003$) with increased workload found between HS-FS, TQS-FS AND QS-FS (MWU: $P < 0.02$) but not for QS-HS, QS-TQS and HS-TQS ($P > 0.05$). These results suggest workload was not consistent across SZs for F2-4 ($P > 0.05$) and horses were therefore not working as the trainer intended. Monitoring speed and workload during galloping could provide trainers with a more accurate approach to training than using allocated speed zones and judging performance through observation.

Lay person message: Monitoring racehorses' speed and heart rates during training can provide their trainers with an indication of how training is progressing. Racehorses' average workload and speed was recorded and analysed against trainer-allocated speed zones (SZ) to see if differences existed. Speed did increase between the SZ but no difference was found between quarter and half of maximum gallop speed. Similarly, racehorse workload only varied during the first furlong of work, regardless of the SZ they were working at. Monitoring speed and workload could provide trainers with a more accurate approach to training than using allocated SZ and judging performance through observation.

Keywords: interval training; horseracing; heart rate; fitness; equine welfare, speed.

Effect of a weighted riding aid on rider weight distribution

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Training and performance difficulties can be related to horse and rider asymmetry. Rider asymmetry commonly occurs due to natural laterality or injury and can lead to the horse receiving unclear and/or inconsistent signals, becoming confused which ultimately has a negative impact on horse welfare. The use of bespoke sports equipment to engage and strengthen a rider's core, and subsequently their balance and posture, is becoming increasingly popular. Establishing core strength and stability during riding also enhances the rider's ability to maintain a stable position and to remain supple in order to move safely with the horse. A weighted rubber cube has been marketed as a multidisciplinary core strength training tool for equestrians that improves communication with the horse by building core strength and reinforcing classical rein control. This study aimed to determine the effect of engagement of the rider's core using a weighted cube (=1.3kg) on rider weight distribution (left-to-right side). The body weight and left:right leg weights (kg) of a sample of n=22 right-handed female riders (24.9±9.71 years old) was measured with one foot on each of a pair of digital scales, whilst taking up the tension on a set of reins attached to a static horse model to eliminate horse related factors. Riders were then given the weighted cube to hold with the reins in order to engage their core, and their left and right weights (kg) were recorded again. Riders were blinded to their weights throughout. Rider weight data were parametric (AD=0.1939; P>0.05; n=88). Sixteen riders maintained their left or right preference when holding the cube (n=10 right; n=6 left) and six riders changed their preference (n=3 left-to-right; n=3 right-to-left). Significantly more riders maintained their preference (Chi^2=4.54, P < 0.05) and subjects became significantly heavier overall when holding the cube (cube weight subtracted from total rider weight; t=8.11, df=21, P < 0.001; before 66.7+-10.6 kg; with cube: 67.9+- 10.64kg). All riders were right handed and interestingly the weight through the right leg was significantly greater when holding the cube (35.4+-6.2kg) than before (34.0+-6.09kg; t=2.54; df=21, P < 0.05). Use of the weighted cube designed to engage the rider's core did not improve symmetry, and likely balance either. Interestingly the rider's weight appeared to increase (beyond the 1.3kg of the cube), suggesting that cube use may have detrimental effects on the horse. It is important to appreciate the full effects of using riderrelated interventions on the horse.

Lay person message: Rider asymmetry is common due to people having a naturally dominant side and can make it difficult to give the horse clear physical aids. A rider who 'engages their core' is believed to be more physically effective than one who does not. Assessment of rider weight distribution whilst holding a 1.3kg weighted cube designed to engage core muscles and reins attached to a static horse model showed that it increased rider weight significantly and that right handed riders became more 'right leg dominant'. It is important to fully understand the impacts and side-effects of the use of rider training aids on the horse's welfare.

Keywords: rider; equine; aid; core; weight; welfare.

Voluntary rein tension in amateur competition horses moving unridden in a dressage frame and comparison with ridden conditions of the same horses with their usual riders

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Rein tension is an important factor in horse riding- too much tension may compromise the welfare of the horse. But who generates the tensile forces on the reins- the horse or the rider? The aim of this study was to examine the maximum rein tension that horses voluntarily choose without a rider, when moving in a dressage frame. The same horses were also ridden to compare, if there is a difference in the occurring forces without and with a rider. Six horses were used in this pilot study all fitted with customised "Animon" rein tension sensors (25Hz, up to 600N range) in a round pen or longe hall, free moving with side reins in competition frame with the nose line at the vertical. The horses were measured in walk, trot and canter on both reins. The same horses were then ridden by their usual riders, again in walk, trot and canter on both reins in their usual dressage frame. Video recordings were taken and the R-R-intervals (Heart Rate Variability) were measured with a polar H7 equine sensor. The horse-rider-pairs were at least at an amateur competition level. The mean maximum peaks of the rein tension data were tested with the MannWhitney-U-test ($p<0.05$). Horses at liberty in the round pen needed significantly lower rein tension (MannWhitney U=711136.5, N= 3250; 9.58N±6.8N) to maintain the dressage frame, than the ridden horses (Mann-Whitney U=711136.5, N= 2733; 31.25N ±23.37N). The rein tension in the ridden condition was thrice as high as in the unridden condition. It may be suggested, that the bigger part of the tensile forces is generated by the hands of the riders or that other conditions influence the reactions of the horses. It is possible for the horses in this study to maintain a dressage frame with about 10 N of rein tension- so the riders must take special care to learning theory and the pressure release of the rein tension to transfer this results into the ridden condition. A limitation to this study is the small number of horses, as this was only the pilot study.

Lay person message: All horses in this pilot study, regardless of being ridden with higher or lower tension on the reins, maintained without rider and equipped with side reins voluntary forces on the reins of around 1 kg in all gaits. The ridden horses needed significantly higher forces of around 3 kg on each side to maintain the dressage frame. Understanding and lowering the peak forces acting on the horses' mouths could enhance the welfare of horses in daily riding practice.

Keywords: rein tension, riding, peak forces, welfare, dressage, horse.

The effect of introducing extra walk breaks on various physiological aspects in a specific (T1) tölt final for icelandic horses

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The aim of this study was to substantiate whether or not the change that is made in 2014 in a specific tölt final test (T1) for Icelandic horses has been the correct decision with regards to horse welfare. The alteration has been made based on empiricism. The second aim was to gather more information on the physical state of the Icelandic horses and their training, as recommended in two studies of G.J. Stefánsdóttir et al. The results of this study may serve as reference data for the FEIF (International Federation of Icelandic Horse Associations). In this study 8 Icelandic horses were monitored performing standardized tests in a cross over design. At day one 4 horses (group A) performed T-old (the original final test) whereas the other 4 (group B) performed T-new (the new final test with walk breaks in between). On day 7 group A performed T-new and group B T-old. During their total performance warming up, test and cooling down, heart rate (polar system), venous blood lactate concentration and rectal temperature were monitored. Comparison of T-old with T-new showed that the HR in both tests and the average speed were in general comparable, the mean total distance of T-new test is approximately 500 meters more and the total duration longer. The mean lactate concentration after the third section (fast tölt) of T-old tended to be higher than T-new ($P = 0.07$, paired t-test). The mean increase in lactate concentration in T-new was significantly lower than in T-old ($P < 0.05$, paired t-test). Two horses showed a significantly higher lactate concentration in T-new (both $P < 0.05$, paired t-test), in T-old there was no significance (both, $P = 0.06$, paired t-test). Mean rectal temperature T-new was higher than that of T-old ($P < 0.05$, paired t-test. The new test possibly relies less on anaerobic metabolism and may therefore cause fewer injuries. However the mean rectal temperature seems to be getting higher, therefore more research is warranted.

Lay person message: In 2014, the FEIF made an adjustment to a final tölt test by introducing walk breaks. The introduction of the walk breaks was done in order to help the horses recover in the heaviest tölt test and therefore to reduce injuries. The data from this study show that the test has become longer and decreases the anaerobic part of the total effort. More research is warranted with regards to the rectal temperature increase induced by these tests in order to optimize horses welfare. By introducing these walk breaks, the test becomes longer more like an interval demand program. Has introducing of these walk breaks the desired effect? We want to increase information, knowledge and awareness among riders, trainers and judges of what we demand from our horses.

Keywords: Icelandic horses, physiological response, heart rate, tölt, lactate, temperature.

Persistence of behaviour as foals develop

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The behaviour of horses can influence work and sports potentialities and also can be influenced by routine management and training technics, frequently conducting to distinct performance, human: horse relationship and well-being of horses throughout their lives. Usually, the temperament of horses is evaluated when they are adult or near weaning. If it could be accessed at birth, this information would contribute to tailor-made training programmes, as well as early identification of horse abilities and suitable rider styles, and so improve horse: human relationship and well-being of horses throughout their lives. Considering genetic improvement, it is expected fewer environmental effects influencing behavioural traits when accessed in younger horses compared to older ones, conducting to more accurate information. We compared the temperament of 25 foals at birth and when older, and between different tests, looking for correlations that could validate the early temperament assessment. On their first day of life and at haltering (about seven months of age) the parameters curiosity (attention to human), ticklish (uncomfortable when petted), courage (acceptance of human approach) and tension were recorded. At about one year of age, the same foals were tested individually by placing a trunk (30cm diameter) along the gate to their pasture, recording: activity (spontaneous movement), exploration (approaching new object) and transposition of the trunk (efficiency in transposition). Foals that showed greater courage (Spearman correlation, rs = 0.50, df = 23, P = 0.01) and less tickling (rs = 0.60, df = 23, P = 0.002) at birth and lower tension (rs = 0.56, df = 23, P = 0.003) at haltering were more active during the novel object test (trunk) than the others. The foals that showed greater courage (rs = 0.51, df = 23, P = 0.01), less tickling (rs = 0.49, df = 23, P = 0.001) and lower tension (rs = 0.39, df = 23, P = 0.01) at birth and lower tension (rs = 0.57, df = 23, P = 0.03) at haltering approached faster the trunk than the others. Those who showed greater curiosity (rs = 0.48, df = 23, P = 0.02) at birth and lower tension (rs = 0.48, df = 23, P = 0.02) at haltering transposed the trunk more efficiently than the others. The study identified consistency of behaviours presented at different ages. The tendency for greater frequency of significant correlations at birth in comparison to haltering may be due to environmental effects such as management and training. This study indicated that the early temperament assessment of horses could optimize training, use of labour and animal welfare, especially with the most sensitive foals. New studies should be conducted on the stability of equine behavioural parameters, as well as more efficient training and management techniques for horses with different personalities.

Lay person message: In order to achieve a better social living with humans, horses partially adapt their natural behaviour. The identification of the personality and good management practices since foals might help in achieving the best performance and wellbeing of horses. We evaluated 25 equines in 3 phases of their lives. It was pointed out that the more curious and brave, and the less tickling and tense foals showed better performance when presented to unknown object when older.

Keywords: foals; equine breeding; haltering; gentle handling.

A pilot study into the effect of conflict behaviours on the heart rate of horses during ridden transitions

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Existing literature focuses on the psycho-physiological parameters of conflict behaviours (CB) and heart rate (HR) in individual settings, with little expansion on the relationship between the two, other than their association with stress. As stress is indicative of negative influences on the horse's welfare, it is clear why these variables are so extensively studied. However, previous research introduces concepts that may explain the connection between HR changes and CB performance, but without experimental data, these theories cannot be authenticated. This study aimed to investigate whether CB affected the HR of the horse during ridden transitions. Five (n=5) leisure horses were used; all geldings, aged between 5 and 23 years old (median = 12 years old) and of various breeds. During individual tests, each horse was fitted with a HR monitor and asked to perform eighteen ridden transitions between the gaits of halt and trot. Transition order was determined by random crossover. The ridden tests were videoed, and the footage observed to record CB, behavioural intensity score and gait (halt/walk/trot) score, each from pre-determined systems. Statistical analysis and graphical representation were completed using MiniTab 18© and Microsoft Excel, respectively. Results from a series of Kruskal-Wallis tests, to determine whether HR increases with behavioural intensity for each horse individually, were non-significant. A one-way analysis of variance (ANOVA) test gave significantly different results when comparing behaviour type and intensity ($F_{4230} = 4.61$, $P = 0.001$), with NT (nose tilt) and TS (tail swish) being displayed in lesser amounts than other behaviours. When comparing increases in HR with the type of CB behaviour performed (one-way ANOVA test), a significant difference ($F_{4230} = 4.61$, $P = 0.001$) for the behaviours HM (head movement), PB (playing with the bit) and EP (ears pinned) all correlated with higher HR scores. The results from this study, particularly those surrounding the absence of correlation between HR and overall behavioural changes, support the theory of conditioned suppression, although further, more extensive studies should be conducted. However, when comparing behaviours on an individual basis against HR, correlations were found, which may corroborate with another concept rather than conditioned suppression. NT and TS being displayed in lesser amounts is not supported by literature and a larger sample size would be required to determine its relevance. Improvements to the methodology are suggested, specifically those surrounding the use of gait scoring as this process did not allow for reliable analysis of graphical results.

Lay person message: A ridden horse can demonstrate raised levels of stress when experiencing confusion caused by mixed signals from its rider. Stress has been seen to increase heart rate, although it is not known how conflict behaviours align with this physiological measure. This study has shown that some behavioural reactions from the horse and their relationship with heart rate values could indicate a stress response known as conditioned suppression, but further research would be needed to justify this suggestion.

Keywords: conflict behaviour; welfare; stress; heart rate; conditioned suppression.

Is there a correlation between heart rate and behaviour exhibited by equines in response to an audience?

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The domestication of animals by humans has invariably affected their welfare with an increase in exposure to stressors, and in equines the consequences have impacted on their wellbeing. In equine sports, welfare has been investigated extensively in contemporary literature, however there appears to be a lack of research examining the effects of competition scenarios on undesirable behaviours associated with increased HR. The aim of the study was to determine how equines are affected by an active audience and how this may limit their performance during sport events. College horses (n=7) who either have competed or are competing with a mean age of 13.7 years old were used in the study. Each horse was ridden in walk by the same control rider and filmed by an independent observer for three continuous 20 metre circuits in a familiar outdoor arena. Which Heart rate (HR) monitors were used during the study, and behavioural frequency and occurrence recorded from the results of the videos using a ridden ethogram. Behaviours measured included RH (raised head), EM (ear movement), EB (ears pinned back), TS (tail swish) and SP (speeding up). During the first circuit, no audience was present. For the second circuit, a silent audience stood outside the arena, and during the third circuit this audience clapped and cheered. Data were processed in MiniTab 18© using a series of one-way ANOVA tests and linear regression. EM was observed significantly more than any other behaviour ($F_{13,465} = 12.67$, $P = 0.000$). However, there was no significant increase between the frequency of behaviours observed and progression of the study ($F_{33,408} = 1.00$, $P = 0.479$). When analysing HR, there were no significant differences found between peak and minimal HR and each individual circuit ($F_{2,18} = 0.56$, $P = 0.385$ and $F_{2,18} = 1.01$, $P = 0.385$ respectively). However, when a linear regression analysis was performed, the average HR significantly increased as the study progressed ($P < 0.000$). The same test also discovered a statistically significant negative correlation between behaviour frequency and HR ($P < 0.000$). Therefore, no significant escalation of behavioural frequency was observed to correlate with the increase in average HR as the study progressed. In a competition scenario horses may therefore be displaying an increase in HR due to another factor that could affect performance. Further research could be carried out with an increased sample size to discover any difference or cause of these results.

Lay person message: Horses are often exposed to loud audiences when competing, which may affect their welfare by increasing undesirable behaviours or raising HR. It would be advantageous to improve performance through better understanding of the effects and what could be done to minimise any stress. In this study an increase in HR, but not behaviour was seen, so reasons for this need to be explored fully.

Keywords: equine; stress; behaviour; heart rate; performance; welfare.

The effect of different mounting heights and methods on conflict behaviour expression in college horses

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Previous studies show an increased mounting height decreases peak pressure across the horse's withers and back, however no studies evaluate behavioural implications of varying mounting heights and resulting stress imposed upon the horse. Conflict behaviours (CB) are widely used in research when evaluating welfare and are often indicative of pain. This collection of studies investigated the expression of CB during mounting. A pilot study (PS) from initial ideas developed into separate studies (E2 and E3). These improved on flaws identified in PS, therefore three separate sets of data existed for statistical evaluation. All studies used five horses (n=5) of various ages, breeds and heights. The same experienced rider took part in all three experiments. Six mounting methods occurred for each horse in each study: leg up (LU), ground right side (FR) and then left side (FL). Next a three-step mounting block, with heights of 19 centimetres (cm) (H1), 36 cm (H2) and 53 cm (H3). E3 additionally had measurement from the ground to the stirrup minimising the effect of varying heights. The observer used an ethogram to tally frequencies of CB in each experiment, which were videoed and corroborated by an independent observer. From the PS the CB measured were ears back (EB), shifting weight (SW), teeth grinding (TG), tail swishing (TS), walking on (WO), flicking ears (EF) and head tossing (HT). No direct comparison between the three separate studies was possible due to varying factors including time, weather and measured stirrup height in E3. A one-way ANOVA conducted on data from the PS found observations of LU and H3 presented significantly less CB than any other height ($p<0.05$). A series of Mann Whitney tests found LU to produce significantly less CB intensity across all heights ($p<0.05$). Results from E2 and E3 used a one-way ANOVA to determine statistical significance of CB exhibited across all heights. E2 reported FL produced significantly more CB than any other height ($F = 7.31$, $P < 0.000$). Interestingly E3 saw no significant results ($F = 1.14$, $P < 0.197$) across any measures. Reasons for this may be weather as E3 took place in windy conditions. However, results from the PS and E2 imply horses experience less CB when mounted with no weight in the stirrup, and most CB from the ground on the left side. Different mounting heights may affect prevalence of CB indicating more research could substantiate these findings and produce guidelines for mounting to benefit horse and rider.

Lay person message: There is no official guidance to state the method of mounting horses that is most beneficial for their welfare. Measuring conflict behaviours expressed during mounting may discover if a particular method can be recommended. It appears from this research that riders should be encouraged to use methods involving no weight placed in the stirrup; such as providing a leg up or the practice of utilising a higher mounting block.

Keywords: mounting methods; welfare; behaviour; training; back injury; safety.

Are stereotypic OTTBs (Off–The–Track Thoroughbreds) harder to rehome than non–stereotypic OTTBs? – A pilot survey

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Several studies have indicated higher incidence of stereotypic behaviours (STB; e.g. crib-biting, weaving, box-walking) in Thoroughbreds, particularly if they spent time in a racing career that might involve risk factors, e.g. individual stalling. The aftercare of OTTBs has received increased attention in the last decade. TAA (Thoroughbred Aftercare Alliance) accredits centres throughout North America that work to rehome OTTBs in a safe, welfare-friendly manner. Though the authors have suspected that having an STB would make OTTBs more challenging to rehome (assuming other factors are approximately equal; e.g. colour, size, adoption fee) this hypothesis remains to be empirically tested. The objective of this study was to establish a collaborative survey to investigate STB in OTTBs among 54 TAA accredited centres throughout the U.S. Using an openly available online database, we contacted each centre using mixed mode, multiple contact survey methods. 38 centres responded (70% response rate). Respondents represented 987 OTTBs taken in over the past year. Of the accepted horses, respondents stated that 17% (n=172) had one or more STBs (a higher rate than most previous studies). It was noted in the qualitative remarks that many respondents felt horses that arrived as weavers would often 'come out of' that behaviour as they settled into their postracing life. One question asked: how does having an STB impact a horse's likelihood of being rehomed? (from 1 = 'Makes them much easier' to 5 = 'Makes them much more challenging'); 92% indicated having an STB made horses somewhat/much more challenging to rehome, thus confirming our hypothesis ($P < 0.0001$; $df = 4$). A subsample of the study population (Florida-based TAA centres; n=6) were asked additional questions. Florida centres reported recreational riders as their most frequent clientele, followed by clients searching for companion horses/pasture pets, and professional riders as their least frequent prospective adopter/purchaser. STBs observed from most to least common at these centres were cribbing, followed by box-walking and weaving. When asked if price varies when having an STB, 40% reported the price is slightly lower. 33% of respondents reported STB Thoroughbreds are somewhat more challenging to train for new purposes than non-STB OTTBs. While we recognize there are limitations in interpreting selfreported survey data, the findings suggest further research is warranted (e.g. video footage assessment of STB rates while horses are in the track environment compared to their aftercare environment and investigation of prospective owner perceptions of OTTBs with history of STB).

Lay person message: This study investigated stereotypic behaviours (STBs) in off-the-track Thoroughbreds (OTTBs) and the influence of STBs on the ability of aftercare centres to rehome OTTBs. STBs were found to have a negative impact on rehoming OTTBs. One aim of equitation science is to better understand equine welfare during training and competition. Rates of STB have often been associated with suboptimal welfare at some point during the horse's life. Readers are reminded that a horse's current STB does not necessarily imply that its current welfare state is compromised.

Keywords: off-the-track Thoroughbreds; stereotypic behaviour; survey; retired racehorses.

The impact of auditory stimulation on equine nocturnal behavioural profiles

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Environmental enrichment (EE) can promote the display of biologically relevant behaviours within hypo- or hyper-stimulating environments, which can also aid in reducing stress. This study considered if nocturnal musical enrichment resulted in reduced frequency of alert behaviour and an increase in sleep-related behaviour for horses stabled overnight. Frequency of behaviour according to a pre-determined ethogram was recorded for seven horses (mixed sex/breed/height, age range 6 to 16 years) housed on the same yard and receiving the same daily management routine. Horses were observed over nine consecutive nights from 1900 to 0700 in their usual routine using focal continuous sampling and an infrared CCTV camera system. The first two nights established baseline nocturnal behavioural patterns (phase 1), followed by five nights where horses were exposed to Beethovens' 9th Symphony played at an average of 62.3 decibels (phase 2). Two further non-consecutive nights of observation allowed behavioural data collection when music was no longer played (phase 3). The study gained ethical approval from the Hartpury Ethics Committee. Wilcoxon Signed Rank was used to determine differences in frequency of behaviour between pre-, with and post- music nights, whilst a Related-Samples t-Test was used to determine differences in frequency of behavioural switching between the three phases (significant at $P < 0.05$). Frequency of ingestion was highest in phase 2, which was significantly different ($Z = -2.46$; $P = 0.019$) to phase 3, but not phase 1 ($Z = -1.73$; $P = 0.084$). Frequency of locomotion significantly decreased from phase 1 to 2 ($Z = -3.06$; $P = 0.002$) and remained low, with a significant difference noted between phase 1 and 3 ($Z = -2.98$; $P = 0.007$). Generally, the frequency of lateral recumbency increased from phase 1<phase 2<phase 3 but no other significant differences were noted. Behavioural frequency remained relatively consistent during phase 2, with no significant differences between nights 3 and 7, although frequency of ingestion was observed to decrease while head over stable door increased. Behavioural switching occurred less frequently while music was played, and this was significantly different to both phase 1 ($t = 2.46$; $P = 0.029$) and phase 3 ($t = -2.59$; $P = 0.022$). Music appears to result in longer behavioural bout duration, although curiosity appeared to increase towards the music stimulus during exposure to music. The addition of music appeared to reduce restlessness and encourage more biologically significant behaviours and might thus be considered useful in equine husbandry practices, for example to facilitate seasonal changes such as overnight turnout to stabling during the winter.

Lay person message: Welfare of all animals in an indoor environment is of great importance and trying to improve that environment is an ongoing challenge. Little has been done to understand the nocturnal environment or how to enrich it. Music is known to influence horse behaviour and in this study the addition of music appeared to both reduce restlessness and be associated with the occurrence of biologically significant behaviours, for example sleep-related behaviour.

Keywords: horse; environmental enrichment; nocturnal behaviour; auditory stimulation.

The effect of 'designer' bits on the behaviour of show jumping horses

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Equine bits are a crucial part of communication between horse and rider. Modern technology has led to the development of a variety of 'designer' bits, however little is known about their action on the oral tissues because of the inability to visualise bit movement during exercise. Behavioural analysis may however provide insight into bit acceptance. This study aimed to assess the impact of two 'designer bits' on the behaviour of showjumpers. Thirteen horses on a professional yard were each videoed performing their usual warm-up for 15 minutes in their usual snaffle bit to provide a baseline, then divided into three groups; Control (C) ridden in their own bit (n=3), Verbindend (V) (n=5) and TurtleTactio (T) (n=5). The Verbindend is designed to spread pressure across the width of the tongue whilst the TurtleTactio focuses the pressure on the central part, pressure distribution being previously determined by validated mathematical methods. Horses were ridden in their allocated bit a minimum of three times a week for eight to ten weeks prior to re-test (dependant on competition schedule). Each horse was ridden by their usual work rider throughout (n=3). All videos were analysed by three trained and blinded assessors using an ethogram comprising six state and nine conflict behaviours. The Wilcoxon Signed Rank Test was used to compare baseline to final measurements for each group. A significant decrease in flight response ($Z = -2.023$, $df = 9$, $P = 0.043$) and increase in excitement ($Z = -2.043$, $df = 9$, $P = 0.041$) were seen when V and T groups were considered together with data pooled, to show the overall impact of a bit change. Individually the bits showed no significant effect on state behaviours. The V group showed no significant difference in conflict behaviours over the study; but did show a trend for decrease in frequency of tail swish, rear, and open mouth. The T group showed a converse trend with an increase in tail swish and open mouth and a significant increase in ears back ($Z = -2.023$, $df = 4$, $P = 0.043$) and headshake ($Z = -2.032$, $df = 4$, $P = 0.042$). No significant differences were seen in the control group for any behaviour. Several behavioural changes were noted as a result of changing the bit. The impacts of bit design and pressure distribution on the horse's mental state is an under-researched area with potentially wide-ranging applications for both welfare and performance. Further research is required to fully assess the impact of both commonly used and novel bit designs on horse welfare.

Lay person message: Designer bits are flooding the equestrian market, but how they work inside the horse's mouth is not known. This study used behavioural observations to assess whether bit design has an impact on the behaviour of showjumpers which may affect their performance and welfare. The findings of this study showed less adverse behaviour in the horses with a bit that applies pressure over the width of the tongue when compared to one that focuses bit pressure to the centre of the tongue. Bit manufacturers must therefore carefully consider their designs before bringing them to market.

Keywords: behaviour; ethogram; bit; training; show jumping; welfare.

Genetic parameters for laterality in thoroughbred racehorses

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Little is known about the genetic background of laterality and its importance to race horses. In case of sufficient genetic variance, selection for laterality might be possible, providing a chance to breed more well-balanced horses. The aim of the present study was to estimate genetic parameters for a measure of laterality (lateral displacement of the hindquarters from the median plane in gallop, as previously validated in riding horses) in racing Thoroughbreds. Video records of a total of 1822 Thoroughbreds during races of various levels on race tracks in Germany of either clockwise (n=699), counter-clockwise (n=485) or both (n=643) directions over consecutive years were available for analysis. Laterality was assessed from behind with video analysis while racing and assumed to be a linear trait, i.e. coded -1 for left-lateral (n=383) and 1 for right-lateral (n=778) horses. If a horse changed direction of displacement of their hindquarters during a race, or if it showed different directions of displacement on clockwise and counter-clockwise racetracks, it was considered ambidextrous and coded 0 (n=661). Furthermore, pedigree (n=7463 horses in total) and competition-related data (number of wins, number of placings, earnings, handicap, best distance) of horses was collected from the German Thoroughbred breeding association's database. Genetic parameters were estimated via uni- and bivariate linear animal models using the software DMU6. Laterality was lowly related to the preferred canter lead in either direction (both rp=0.2, $P < 0.0001$), and a stronger right-bias (mean laterality score ± SD: 0.37±0.83 vs 0.14±0.84 T-Test: $P < 0.05$) was observed on counter-clockwise racetracks, but all combinations of laterality with racetrack directions occurred. Heritabilities from univariate models were: laterality: $h^2=0.19$, placings: $h^2=0.72$, wins: $h^2=0.66$. While phenotypic correlation between laterality and number of wins was low (rp = 0.13), genetic correlation was high (rg=0.82±0.19), suggesting that laterality might be a useful indicator for genetic merit for racing success, and that horses with their hindquarters displaced to the right might be genetically superior racehorses. The relationship was similar for laterality and number of placings (rp = 0.13, rg=0.70±0.16). However, when interpreting the results, the relatively low sample size for estimation of genetic parameters needs to be kept in mind, which might explain the high heritabilities for number of placings and wins. Furthermore, future analyses should investigate different trait definitions and assumptions of genetic architecture such as, for example, considering laterality as a binary rather than linear trait (e.g., ambidextrous vs. either right or left lateral).

Lay person message: Horses' lateral displacement of the hindquarters relative to the forequaters during gallop appears to have a genetic component. Furthermore, displacement of the hindquarters is genetically linked to racing success, such that Thoroughbreds with hindquarters displaced more rather than less consistently to the right are genetically superior race horses.

Keywords: laterality; displacement of hindquarters; genetic parameters; Thoroughbred; gallop; racing success.

A study of behavioural responses of abruptly and gradually weaned foals to mare separation

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Weaning-related stress in foals is recognised globally and management approaches at this time should aim to minimise its welfare implications. A range of weaning methods are employed worldwide, reflecting a lack in universal agreement as to preferred method in terms of being least stress-inducing for the foal. Domesticated foals are typically weaned around five to seven months, earlier than the eight to eleven months seen in the wild. Both timing and method of weaning used is commonly based on human preference with seemingly little regard to the potential effects on the foal. This study aimed to determine whether gradual or abrupt weaning of foals is preferable on the basis of foal welfare. Fourteen foals (7 colts, 7 fillies; age at weaning =200.71±6.97 days) were randomly allocated to one of two groups. Group 1 foals were weaned using an abrupt method (all mares suddenly removed, foals remained in the same housing). Group 2 foals were weaned using a gradual method (mares and foals separated daily, an additional one hour per day, leading to complete separation by one week). Foals were video recorded continuously for one hour pre-weaning and one hour post-weaning using an Annke 1080P Hi-Resolution IP66 weatherproof digital video surveillance camera. Behaviours were noted using an ethogram. Group 1 foals displayed a greater increase in overall behaviour displayed (Mann-Whitney $W=68$, $P < 0.01$) compared to group 2 foals post weaning. Stress-related behaviours increased in frequency for both groups post weaning (locomotion: 26.85±11.61, $w=105$, $P < 0.0001$, pre 5.08±1.71, post 26.85±11.61, vocalisation: pre n=0, post n=658, defecation: 6.30±3.17, $w=105$, $P < 0.0001$, pre 0.5±0.75, post 6.30±3.17). Group 1 displayed higher recordings of locomotion post weaning compared to group 2 (mean=208.4±36.2, $w=68$, $P < 0.01$). No significant differences were evident between any stress-related behaviours exhibited by fillies and colts. Behaviours exhibited by abruptly and gradually weaned foals during the weaning process indicates that the gradual method may result in less stress related behaviours than the abrupt method, therefore may be considered preferable in terms of potential impact on foal welfare. The long-term impact of weaning stress is a cause for concern, negative early life experiences influence behaviour (including coping mechanisms) in adulthood. Weaning-related stress also has a physiological impact and may also affect trainability. The welfare of the horse is arguably compromised both during weaning and potentially life-long, favourable weaning conditions may alleviate these concerns, however further investigation is needed to confirm best practice.

Lay person message: Weaning induces stress in foals which can have a negative effect on the foal's welfare in both the short and long term. The behaviours shown by abruptly and gradually weaned foals were observed and compared. Analysis of the behavioural data suggests that gradual weaning methods may be less stressful than abrupt weaning methods. Given management related events such as weaning can shape future behaviour in equids, it is important to utilize the least stressful method as possible.

Keywords: equine; weaning stress; abrupt; gradual; behaviour; welfare.

The influence of rider: horse bodyweight ratio on equine gait, behaviour, response to thoracolumbar palpation and thoracolumbar dimension: a pilot study

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There is limited scientific evidence concerning the effect of rider weight on equine welfare and performance. The objectives therefore were to assess gait, behaviour, responses to thoracolumbar palpation and changes in back dimensions in horses ridden by four riders of similar ability, but different bodyweights. This was a prospective cross-over randomised trial. Six horses in regular work, 500-600 kg bodyweight, were ridden by four riders (rider bodyweight:horse bodyweight ratio 10-12% [L=Light], >12≤15% [M=Moderate], >15<18% [H=Heavy], >20% [VH=VeryHeavy]), performing a standardised dressage test (30 minutes). Video recordings of predefined parts of the test, of similar duration, were evaluated by a trained assessor for the presence of 24 previously validated behavioural markers which may reflect musculoskeletal pain. Grading was binary (yes/no) and applied to trot and canter. The test was abandoned for ≥grade 3 lameness or ≥10 behavioural markers (assessed in real-time). Thoracolumbar dimensions were measured using a flexible curve ruler at three sites (18th thoracic vertebra, T18, T13 and T8) before and immediately after exercise and the presence of epaxial muscle tension or pain was graded yes/no. All 13 H and VH rider tests were abandoned (lameness, n=12; behaviour, n=1), as was one of 12 M rider tests (lameness). The mean time for abandonment was 16.6 minutes (range 9.0-25.5) for rider H and 8.3 minutes (range 6.0-19.0) for rider VH. There was a significant difference in total sum of behavioural markers according to riders for trot (Anova, Bonferroni: M to H $P<0.01$; L and M to VH, $P < 0.001$; H to VH, $P < 0.05$), with markers correlating to rider weight ($R = 0.4$, $P < 0.01$, Spearman). Markers reflecting head position and facial expression significantly increased with the heavier riders. Muscle tension scores increased significantly for riders M and H ($P < 0.05$); there was a trend for increased pain score for rider VH ($P=0.08$). The mean change in thoracolumbar width after exercise was significantly different between rider L and riders H and VH ($P = 0.02$). Mean thoracolumbar width increased with riders L and M (3.9% and 1.9%, respectively) and decreased with riders H and VH (-3.4% and -2.8%, respectively). Saddle-fit was not ideal for riders H and VH, which influenced force distribution and magnitude, a commonly observed clinical scenario. Riders M and H had a similar body mass index (overweight), but only one of rider M's tests was abandoned, suggesting that the transient induction of lameness was related to rider bodyweight, compounded by the rider's position in the saddle.

Lay person message: Six horses were ridden by four riders of similar ability but different sizes. All tests for the heavy or very heavy riders were abandoned because of temporary lameness (12) or demonstration of behaviour indicative of discomfort (1). The results do not mean that heavy riders should not ride but suggest that if they do they should ride a horse of appropriate size and fitness, with a saddle that is correctly fitted for both horse and rider.

Keywords: Lameness; body mass index; saddle fit; ethogram; facial expression.

Zylkene to load? The effects of alpha–casozepine supplementation on behaviour and coping in horses during loading

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Horses are routinely transported for veterinary care, breeding, sale or moving yard. However, transport is a known stressor in horses and can result in problem behaviour during loading. Existing literature and manufacturers recommendations suggest that Zylkene (alpha-casozepine, AC) may be effective in improving the behaviour and welfare of horses during loading onto a vehicle for transport. The current research assessed the effects of a commercially available AC feed supplement on behaviour and physiology in horses during loading and confinement on a lorry. Subjects (N = 10) were mixed breeds, comprising six geldings and four mares, aged 8-25 (mean = 12.6; IQR = 5.25) and were experienced travellers with no known phobia to transport. All subjects were loaded and confined for 5 minutes, once with AC and once without two weeks apart, acting as their own control. Treatment order was randomised in a counterbalanced design. The same handler was used for all tests and was blind to treatment, removing the need for placebo. Dosage was 1000mg for subjects < 500kg and 2000mg for subjects > 500kg mixed in normal feed each morning for 4 days up to and including the day of testing, as per manufacturer's instructions. Time to load onto the lorry, and movement of feet, licking and chewing, and vocalising within the lorry were recorded as behavioural indicators of compliance and coping. Heart rate (HR), heart rate variability (HRV), infrared thermography (IRT) of core temperature and discrepancy in temperature between eyes, and changes in salivary cortisol (SC) were measured as indicators of arousal. HR/HRV were measured continuously during loading and confinement. IRT was measured in the stable, after loading and after confinement. SC was measured in the stable and after confinement and the change in SC calculated. Horses loaded significantly more quickly when supplemented with AC (Wilcoxon: V = 7, N = 10, P = 0.04). However, AC had no significant effect on stress physiology or behaviour during confinement (P > 0.05 for all tests), indicating that it does not affect a horse's ability to cope with loading and confinement in a horse lorry. Post-hoc analysis indicated sufficient power (power > 0.8) to accept findings. Further work is required to ascertain whether the maximum dosage might affect coping and behaviour in horses. In addition, it is not clear whether the difference between control and treatment would be differentiated or attenuated by testing subjects with known anxiety responses during loading.

Lay person message: Horses are routinely travelled for veterinary care, breeding, sale or moving yard. However, transport is a known stressor in horses and can result in problem behaviour during loading. Zylkène Equine may help support good training by reducing anxiety and allowing the horse to learn. However, our results indicate that it doesn't improve horses' ability to cope with loading and confinement on a lorry. Although horses loaded more quickly when treated, no measures of stress, or behaviour within the lorry, were improved. We used the minimum recommended dosage and future studies should assess whether higher dosage improves coping and behaviour.

Keywords: loading; alpha-casozepine, coping, stress, transport, anxiety.

A preliminary study to investigate the prevalence of pain in competitive showjumping equestrian athletes

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The aim of the study was to investigate the prevalence of equestrian show jumping riders competing with pain, the location of their pain, factors affecting their pain and whether they perceived this pain to have an effect on their performance. Eighty questionnaires, containing thirty-four questions, adapted from McGill's and the Oswestry pain questionnaires were completed by competitive show jumping riders. There was no association between age and report of pain (X21 = -0.165, P = 0.114). Participants were 1.42 times more likely to experience pain than to be pain free. Those riders that competed solely in the discipline of show jumping are 2.2 times more likely to be experiencing chronic pain than acute pain. A highly significant association was found between years of riding and pain (X21 = -294, P = 0.004,). Eighty-five percent reported experiencing neck and back pain. The majority of these experienced lower back pain. Sixty-six percent of participants reported experiencing pain in other regions of the body, with the knee being the most common. Sixty-seven percent used over the counter medication with only 9 % using prescription medication to manage their pain. Eighty-five percent of riders perceived their pain to impact on their riding performance. Most commonly they believed that it affected their postural asymmetry (45%), followed by reducing their range of motion (36%), causing fatigue (24%), affecting mood by increasing anxiety and irritability (21%), and reducing concentration (19%). Only 14% of participants directly reported it affecting the horse by causing asymmetry. These findings suggest that pain may affect riders ability to maintain their position, apply appropriate cues to the horse which may impact on equine welfare. The high incidence of show jumping riders who compete with pain, particularly back pain, could be problematic given the longevity of a rider's career, which can span over four decades. This research reports rider's perceptions and self-reported pain and management options, which may affect the data. Further research is needed to establish the causes of back pain and appropriate management strategies.

Lay person message: There is a high incidence of chronic pain, mainly back pain. 85% of riders perceived this pain impacted on their riding performance, which is likely to affect their communication with the horse. Taking over the counter pain medication was the most common pain management strategy used by show jumping riders, which may have long-term health implications.

Keywords: equestrian show jumping riders; chronic pain; back pain.

In–person evaluations disrupt ongoing discomfort behaviour in hospitalized horses

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Horses have evolved to show little indication of discomfort or disability when in the presence of potential predators, including humans. This natural characteristic complicates the recognition and management of pain in horses. To assist veterinary clinicians in identifying potential sources of discomfort behaviour (DB) in patients, we routinely evaluate 24-hour continuous video samples of stalled horses. It has been our clinical impression that, regardless of a patient's ongoing DB, whenever people approach or interact, the horse "perks up" and DB more or less ceases. Unfortunately, this change in behaviour in the presence of people is not widely appreciated. It is particularly concerning that composite pain scoring rubrics that require inperson evaluation do not consider this interruption of ongoing DB. The aim of this work was to objectively confirm and quantitatively describe our clinical impression. We identified a sample of 20 orthopaedic patients for which archived video included a caretaker stall visit (VISIT, either to observe and examine or to administer treatment) that was both preceded and followed by one hour without disturbance. Video was reviewed to record all occurrences of DB (e.g. limb lifting, pointing, attention to affected area, head shaking) during the VISIT and during the preceding and following hours. VISITS ranged from 3.23 to 7.75 minutes. The mean +s.e. number of DB per minute (DBPM) during the preceding and following hours, respectively, were 1.65+0.17 and 1.49+0.22. The difference is not significant (tdep = 1.04, 19 df, P > 0.05). In contrast, mean DBPM during the VISIT was 0.40+0.11. This is significantly lower than during both the preceding and following hours (tdep = 8.73, 6.37 19df, P = 0). All 20 patients expressed fewer DBPM during the VISIT, with a 24 to 100% reduction (mean 77.4% +0.17%). Six of the 20 patients (30%) ceased their ongoing DB altogether during the VISIT. These data confirm our clinical impression that ongoing DB is interrupted when people approach or interact, resulting in under-appreciation of discomfort. We recommend that discomfort evaluations for horses include remote observation. For example, a one-hour video sample obtained when the horse is undisturbed can be scanned at 10-20X real time within 5-10 minutes. While the welfare of hospitalized horses was specifically addressed here, this tendency to show little indication of discomfort or disability in the presence of potential predators likely similarly delays recognition of disease in horses in general.

Lay person message: In 24-hour video-recorded samples of 20 hospitalized horses, ongoing discomfort behaviour conspicuously diminished or stopped altogether when a caretaker approached or interacted with the horse, and then resumed after departure to pre-visit levels. For all 20 patients, the magnitude of difference was potentially important to case management decisions. This raises concern that we routinely underestimate discomfort in equine patients in ways that may compromise welfare. While this is especially of concern for veterinary hospitals, this natural characteristic of horses to show little indication of discomfort or disability in the presence of predators likely also delays recognition of disease in horses in general.

Keywords: horse; pain assessment; discomfort behaviour.

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Poor welfare due to a rare fungal skin disease

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Among diseases caused by fungi (i.e. mycoses) dermatophytosis, cryptococcosis and aspergillosis are commonly reported in horses. Conversely, other mycoses are underestimated, often not suspected or diagnosed. This study presents a rare case of *Geotricum* spp dermatitis. After surgery and antibiotic treatment, a saddle horse (gelding, 11 year old) showed well-circumscribed areas of non-pruritic alopecia. The owner did not promptly call the veterinarian suspecting an allergic reaction. The horse lost more hair and weight; a veterinarian was consulted and corticosteroids were administered since an allergic reaction was suspected. At a different veterinarian examination (1 month later), the skin lesion had worsened with alopecia affecting the face, neck, circumferentially around the lower limbs and shoulders. Large white loosely adherent scale coated affected skin, with thick keratin-rich crusts adherent to the lower limbs. The horse was lethargic, pyretic (40 °C), heart and respiratory rates were increased, and hair was shedding/easily epilated, back legs were swollen, and yellow exudate could be expressed from a skin erosion on the knee. Examination of the blood revealed mild neutrophilia (leucocyte count 14.5 10^3/µl). Anti-inflammatory and antibiotics were administered. Hair, skin scraping and skin biopsy were collected. Routine diagnostic procedures for isolation of bacteria and ectoparasites were performed, but the sample was negative. A fungal infection was suspected and hair and skin scraping samples were examined microscopically using May Grunwald Giemsa method and cultured onto Sabouraud dextrose agar with chloramphenicol (0.4 mg/ mL), and cycloheximide (0.5 mg/mL). Identification was performed on the basis of macroscopic and microscopic features. *Geotricum candidum* was isolated. Impression smears were made from skin biopsy sample and hair samples and examined cytologically, after be fixed in methanol and stained with May Grunwald Giemsa. A clump of *Geotrichum candidum* was found; hyphae were branching, non-parallel walled, with septae. Stable disinfection and baths with local antifungal solution (Virkon S) were performed daily for three weeks, the diet was supplemented with vitamins C and E, the horse grazed at least 6 hours without a rug daily. At the 3 week follow up, the horse had gained weight, the alopecia was decreased, and clinical parameters were normal. The antifungal treatment was continued twice a week for three months. This study suggests *G. candidum* may cause skin lesions in horses after long-term use of corticosteroids or antibiotics. To ensure the principle of good health, in cases of dermatitis veterinarians should promptly be consulted, and appropriate diagnostic procedures should be carried out to reach a diagnosis.

Lay person message: Skin disease can affect the health and welfare of horses. Skin diseases may be difficult to diagnose and treat, because the clinical signs are similar even if the cause is different (infectious or noninfectious). When a horse has a skin problem, a veterinarian should be promptly called, appropriate sampling should be collected, and a differential diagnosis should be offered. Testing available include culture for fungi, bacteria and isolation of ectoparasites. Cytology and histological examination is also recommended. Late intervention, a wrong diagnosis and inappropriate treatment regimens may lead to poor health and welfare.

Keywords: fungal skin disease; health; diagnosis; responsible ownership, welfare.

Stress, reproduction and welfare of thoroughbred horses used in medieval knight competition "SinjskaJ Alka"

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The aim of the study was to determine physical condition and influence of stress in 40 thoroughbred horses used for a medieval knights game "Sinjska Alka". A second goal was to determine the influence of early pregnancy and/or presence and absence of cyclicity on performance, stress and welfare of 12 mares used in the same game. Horses are prepared by traditional conditional methods in the field for 60 days and 3 weeks of intensive training on the game track "Alkarsko trkaliste". The game takes place in August and sexually mature mares were bred in May and June. The trial was performed during preparations and the games (three-day event) "Sinjska Alka". Animals were monitored once weekly throughout the preparations and daily during the games. Monitoring included heart rate immediately after riding and repeated every ten minutes until complete recovery. It also included immediate blood collection for complete blood count, clinical biochemistry and hormonal profiles (cortisol in all horses and progesterone in mares) and individual behavioural score. Our results indicate that conditional training of horses was sufficient since all values even improved during training and competition (increased levels of NEFA, triglicerides and cholesterol due to better adjustment of energetic metabolism). Higher AST and CK levels ($P < 0,01$) in the beginning of this research, as well as CK activity during training, show breed-specific differences in the adaptive process. Higher serum NEFA concentrations ($P < 0,05$) found in the beginning of the study, and lower triglyceride concentrations during training show a significant shift in fat metabolism due to the elevated energy needs. In the same time there was a significant increase of stress indicators during game time (three day event) only since all horses experienced statistically significant prolonged time needed to recover normal heart rate ($P < 0,01$), stress leukogram (mature neutrophilia, lymphopenia, and eosinopenia) and increased cortisol levels. The N:L ratio was significantly higher ($P < 0.05$) during the three day event, especially when animals and riders were wearing traditional folk costumes and medieval horse equipment (final competition) All the significant correlations found between the N:L ratio and the individual behavioural score were negative. All horses had the highest baseline cortisol concentrations at final competition day and exercise caused cortisol concentrations to increase in both mares, stallions and geldings ($P < 0.001$). The best results (least stress) were achieved in the group of pregnant mares and the worst in the groups of stallions and geldings. Non-pregnant mares were cyclical during trial.

Lay person message: Conditional preparation of horses for "Sinjska Alka" was satisfactory. Due to stress parameters it would be wise to introduce the stressors from the final day of game (music, people in crowds, gunfire, medieval horse equipment) as early as possible in order to give horses time to adjust. Since pregnant mares preformed with minimum stress, it would be advisable to make pregnant all breeding mares, used in competition. Since all maiden mares were cycling, it would be advisable to induce oestrus ten days before the game in order to get all maiden mares in luteal phase during competitions.

Keywords: stress, reproduction, welfare, Sinjska Alka, horses.

Future developments in equine influenza intra–nasal vaccination in relation to welfare

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Equine Influenza (EI) is an internationally problematic virus, which because of its welfare and economic implications and continuing evolution is extensively studied. The traditional intra muscular vaccination (IMV) provides good protection when an appropriate strain is used and a correct vaccination programme followed. However, Intra-nasal vaccines (INV) have the advantage of providing increased immunological protection compared to pre-existing vaccines without any physically detrimental effect. There does however seem to be some anecdotal evidence that the public are wary of a possible effect in creating a head shy horse due to its method of administration. This study involved a survey created to obtain information on how much the public know/understand regarding the development of EI vaccines and factors they consider important when deciding to use them. A website was used to create the survey, with a target audience of the public with an interest in equine welfare. Links posted on social media and the website were emailed to contacts within the industry. The survey was open for 12 weeks and received 238 complete replies, which were logged into Microsoft Excel© and then data processed through MiniTab 18©. Overall 34.45% of respondents thought the most important factor when considering using intra nasal vaccines was the horse's welfare. A one-way analysis of variance (ANOVA) reported that a significant number of respondents would ask their veterinary surgeon for information regarding administration of INV ($F = 228.94$, $df = 6$, $P < 0.000$), and a significant number ($F = 25.94$, $df = 1$, $P < 0.000$) responded negatively with regards to their understanding of INV. One Wilcoxon Signed Rank Test was performed suggesting that a significant number of respondents neither agreed nor disagreed that headshaking would be increased by INV ($W=28441.0$, $P < 0.000$). Chi-squared tests showed a negative effect of education on whether they would have their horse vaccinated with INV ($CHI^2=627.917$, $df = 4$, $P < 0.000$) however they also showed a positive relation between education and confidence in administrating the INV ($CHI^2=627.917$, $df = 4$, $P < 0.000$). The veterinary community could play an active role in the adoption of INV and a key role in securing and promoting their use. The next stage of development would be for a reputable company or organisation within the UK or Europe to conduct regulatory compliant studies using the vaccine. Such studies will also help to educate the public, as they would provide an easily available source of reliable information.

Lay person message: Equine influenza can have major welfare implications for a non-vaccinated herd, especially with minimal biosecurity. The traditional equine intra muscular vaccination provides good protection if used correctly. Intra nasal vaccinations however provide better protection and are easy to administer but are only available in the USA. If education, bio security measures and information about the use of intra muscular vaccinations were available through the industry and if the vaccine was licenced and therefore available for promotion through advertising in the UK, more people may opt to use this method.

Keywords: Vaccination; welfare; intra-nasal; equine influenza; education.

The effect of bandages vs. breathable boots on the skin surface temperature of the distal forelimb during exercise in polo ponies

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Tendon injuries account for a significant proportion of performance limiting factors in the modern elite equine athlete. As a result of this, owners use boots and bandages to provide support and protect from trauma. However, the notable effect of bandages on insulating the limb and causing damaging temperatures to the survival of tendon cells is rarely considered and thought to be a common cause of injury. Slowly, tradition in polo is changing from the use of bandages and increasing number of players are turning to the use of boots for distal limb protection. Previous research into the effect of boot on skin temperature is primarily focused on Event horses and skin temperature underneath a variety of boots. The aim of this study, therefore, was to determine the difference between skin surface temperature underneath breathable mesh boots and acrylic stretch pile bandages during exercise in polo ponies. The boots used in the study protect from below the knee to below the fetlock and are flexible yet supportive. Eight polo ponies completed a 15-minute standardised exercise test (SET) comprising warm-up, canter work and cool-down phases, whilst fitted with a thermometer data logger and thermocouples to measure the skin surface temperature of the mid-metacarpal region of the distal forelimb during exercise. Each horse carried out the SET twice, once with boots and once with bandages and temperature was recorded every 10-seconds during the test. Trial order of boots or bandages were randomised and carried out on different, successive, days. Differences between treatments were analysed by students T-Test, differences between boots and bandages over the phases of the SET were analysed using a repeated measures ANOVA. Relationships between skin surface temperature and environmental temperature were analysed by Spearman's Rank correlation. Results showed a significant difference in skin surface temperature between boots (M=22.43, SD=0.09834) and bandages (M=27.70, SD=0.09834), $P \leq 0.001$. Boots produced significantly lower temperature readings throughout the SET, in all three phases, compared to bandages ($F= 53.78$, df 822.28), $P \leq 0.001$. Spearman's Rank Correlation showed that skin temperature underneath boots increased as environmental temperature increased ($R^2 = 0.656$, $P \leq 0.001$). Whereas, bandages showed a very weak relationship ($R^2 = -0.077$, $P = 0.039$) between environmental and skin surface temperatures. Based on these findings, it was concluded that boots have a positive effect on skin temperature during exercise at lower ambient temperatures, compared to bandages. However, the importance of cooling the limb post-exercise is noted as significant in the prevention of tendon injuries and the effect of both treatments on the cooling period remains currently unknown.

Lay person message: Boots and bandages are used by horse owners to prevent traumatic tendon injuries and to provide support. However, materials used can have insulating effects causing potentially damaging temperatures to tendon cell survival. This can result in a weakened tendon structure and increased risk of injury. It was found that boots produced lower skin surface temperatures during exercise compared to bandages. Bandages are traditionally and most commonly used in polo, therefore this could lead to welfare-limiting factor within the industry.

Keywords: tendon injury; performance; polo; hyperthermia; welfare; exercise bandage.

From scientific evidence to improving horse health: using laminitis to understand level of knowledge and implementation of optimal horse–care practices

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Laminitis is a debilitating foot disease that often requires prolonged treatment and can result in euthanasia. Aetiology for laminitis is well researched, but it is unknown whether or how research evidence translates into changes in horse care and improved health. This mixed methods study aims to investigate horse carers' awareness of evidence-based best practices and to identify barriers and drivers affecting the implementation of research-based recommendations. Using laminitis as an exemplar for other important equine health and welfare issues, we will determine whether and how scientific evidence influences horse care. UK horse carers (horse owners and equine yard owners or managers making daily horse care decisions) are being recruited to complete an online questionnaire on their views on equine-focussed scientific research, knowledge of laminitis risk-reducing husbandry practices and whether they are being implemented. After 3 weeks, 804 complete responses had been received. Respondents were categorised as having horses of high, medium or low risk based on their answers to questions about breed (native or non-native) and previous disease diagnosis (laminitis, EMS or PPID). Interim results found that 88% of respondents were horse owners. Of the 22% running equine yards, 40% had a livery yard. A quarter (25%) of respondents cared for horses that were categorised as low risk, 42% medium risk and 33% high risk. Views on scientific research varied. Although 53% believed research findings often contradicted themselves, only 4% felt research to be untrustworthy. A majority (72%) agreed that scientific research formed the basis of advice from vets and 81% thought it had had a positive impact on horse welfare. Horse carers reported practising routine foot care, maintaining an ideal body weight and feeding a balanced diet (79%, 77% and 76% respectively), however only 29% reported not turning out on a bright, frosty morning and 16% reported using grazing muzzles. Horse carers with "high risk" horses had 5.7 times the odds (logistic regression $Z = 8.46$, $P < 0.001$) of practising restricted grazing and 5.6 times the odds (logistic regression $Z = 5.06$, $P < 0.001$) of using a grazing muzzle compared to "low risk" horses. Final questionnaire findings will be used to inform the design of a qualitative, interview-based investigation of horse carers' barriers to and drivers for acceptance of research evidence and implementation of best practices. The ultimate aim is to improve horse health and welfare by mitigating barriers to best practice and optimising communication between researchers and horse carers.

Lay person message: Laminitis is a serious disease in horses, requiring prolonged treatment and can result in euthanasia. Previous studies have identified a number of day-to-day care measures which help to reduce the risk of laminitis. However, it is unknown whether horse carers implement these measures and what the barriers and drivers are for doing so. An online questionnaire is currently recruiting horse owners to understand their views on scientific research and their knowledge of laminitis risk-reducing practices. A series of interviews will form the second part of the study in order to identify the barriers to adopting these practises.

Keywords: equine health; owners; decision-making; "research utilisation"; laminitis.

Development stages of an applied equine ridden ethogram for the assessment of musculoskeletal pain

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Although believed sound, many horses show lameness/gait abnormalities when assessed by an experienced orthopaedic specialist. One specialist with 38 years of experience recognized changes in facial demeanour and body language in horses, when lameness was abolished by local analgesia. The studies reported here aimed to develop ridden behavioural markers to facilitate recognition of musculoskeletal pain. In study 1 the orthopaedic specialist and a diplomate in veterinary behaviour developed a facial ethogram, based on previous research and by 'blind' assessment of head-photographs of 150 lame and non-lame ridden horses. The ethogram was tested by 13 trained assessors (from veterinarians to grooms) using 27 head-photographs. After data analysis for reliability and repeatability, 25/78 facial markers were discarded (mean interrater-agreement 87%). Study 2 aimed to determine if there are differences in facial expression in lame and non-lame ridden horses by assigning pain scores to the developed ethogram markers. A trained analyst (blinded to status) examined still photographs (n=519) of the head and neck of lame (n=76) and non-lame (n=25) horses acquired during ridden schooling-type work. These included 52 images of 7 horses before and after diagnostic analgesia had abolished lameness. Pain scores for lame horses were significantly higher than non-lame horses (+50%; $p<0.001$, W=9180, Mann-Whitney). There was a trend for reduced scores (-20%) after abolition of lameness. Study 3 incorporated body language for ridden horses into the ethogram, based on published conflict behaviour. One experienced observer repeatedly (blind) tested video recordings (clips:50+) of 9 horses (3 non-lame, 6 lame). Behaviours which did not reliably score (yes/no) on reassessments were omitted and 'clusters' further amalgamated. The resulting shorter ethogram was applied to video clips of 13 non-lame and 24 lame horses. For lame horses, behaviours including ears back, mouth opening, eye posture, head tossing/tilting, tail-swishing and crookedness occurred significantly more ($P < 0.05$, Chi-square). This led to a final ethogram of 24 markers, showing high odds-ratios for lameness (>10x likelihood). In Study 4, videos of 10 lame horses were reviewed by a trained assessor, before and after diagnostic analgesia resolved lameness. Fifteen markers occurred significantly more often in lame horses ($P < 0.05$, Wilcoxon) and 4 were only seen in lame horses. Upon pooling data from Studies 3-4 (videos re-analysed with final ethogram) occurrence of ≥8/24 markers during 5-minute observations was a very strong indicator of lameness. Complete blind analysis was difficult but clips with obvious lameness were excluded. Further research into other factors on behaviour is ongoing.

Lay person message: Understanding behavioural expressions of ridden horses can help in recognising musculoskeletal pain in horses. The occurrence of constantly changing head position, mouth opening and shutting, tongue/lip slapping, ears rotated backwards > 5 seconds at a time, intense stare and hind limbs not following track of forelimbs could be indicators of pain. Some of these behaviours do occur in sound horses but if 8 or more occur regularly in a short period, veterinary advice should be sought, because lack of recognition of pain may result in stronger or punitive training aids to the detriment of equine welfare.

Keywords: facial expression; lameness; diagnostic analgesia; pain; behaviour.

Investigation into the stress response of horses undergoing veterinary care

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Equine veterinarians are more likely to sustain an occupational injury than any other civilian profession, with an average of 7-8 significant injuries experienced throughout their career. When a horse enters an equine veterinary facility, there is the potential for a negative behavioural response; posing a risk to people as well as the horse's welfare. The aim of this study was therefore to determine a robust methodology for measuring the responses of equines to veterinary care (VC), to allow identification of common stressors and to inform the future development of low-stress, learning theory informed, potentially safer handling techniques. Thirty-three cases presenting for routine VC at a large equine hospital were recruited, of which 30 cases were included. Opportunistic data collection began on arrival and the horse's response to VC was measured via physiological responses (eye surface temperature (EST), heart rate variability parameters (HRV) and salivary cortisol and behavioural responses (BR). Cases presenting as emergencies or that demonstrated any obvious evidence of pain were excluded. Statistical analysis were performed in SPSS 24 to determine differences between VC and baseline parameters (EST = paired t-test, HRV = Wilcoxon Signedrank test, BR = one sample t-test). These were found to be: EST= clinical examination ($df = 10$, $P < 0.001$), endoscopy ($df = 3$, $P = .010$), perineural or intra-articular injection ($df = 9$, $P < 0.001$), radiographs ($df = 4$, $P = 0.016$), i.v. injection ($df = 8$, $P = 0.001$), flexion tests ($df = 5$, $P = 0.009$), sterile skin preparation ($df = 19$, $P < 0.001$), intra-dermal local anaesthesia ($df = 3$, $P = 0.020$) and placing an intravenous catheter ($df = 5$, $P = 0.004$); HRV= weigh bridge ($n = 14$, $z = 3.3$, $P = 0.001$), clinical examination ($n = 10$, $Z = 2.6$, $P = 0.009$), perineural or intra-articular injection ($n = 16$, $Z = 3.44$, $P = 0.001$), radiographs ($n = 5$, $Z = 2.02$, $P = 0.043$), enter exam-room ($n = 8$, $z = 1.96$, $P = 0.050$), i.v. injection ($n = 20$, $Z = 3.56$, $P < 0.001$), clipping ($n = 7$, $Z = 2.028$, $P = 0.043$), sterile skin preparation ($n = 22$, $Z = 3.62$, $P < 0.001$), intra-dermal local anaesthesia ($n = 6$, $Z = 2$, $P = 0.046$) and placing an intravenous catheter ($n = 6$, $Z = 2.2$, $P = 0.028$). Salivary cortisol levels were consistent with a stress response, however the delayed time to return to baseline prevented determination of response to individual events that occurred closely together. BR to VC varied by procedure, for example, BR to I.V. inj ($df = 18$) included: increased attention on vet ($P < 0.001$), attention on escape or avoidance ($P = 0.013$), increased eye arousal ($P = 0.029$), tension ($P = 0.002$), elevated head ($P < 0.001$), tossing head ($P = 0.18$). Negative responses to veterinary care included; stamps foot ($n = 7$), rears ($n = 3$), kicks with a hind foot ($n = 3$) and barge/crush attempts ($n = 16$). HRV and EST both proved reliable physiological measures of stress during VC.

Lay person message: Many equine veterinarians are injured by horses that find veterinary care stressful. This study investigated the best way to measure what aspects of veterinary care horses find stressful. Each horse is an individual and find different aspects of veterinary care stressful, however certain events were repeatedly found to be stressful across the horses involved. Determination of stressful events will allow future development of low-stress handling techniques. This has the potential to reduce injuries to people and make veterinary care less stressful for horses.

Keywords: stress; veterinary care; horse; thermography; HRV.

Work pattern, hoof abnormalities and lameness in pleasure horses

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Work pattern and hoof abnormalities can be associated with lameness events in horses. Little is known about the work pattern and lameness incidence in pleasure horses. This longitudinal study aimed to establish the work and competition pattern in a cohort of pleasure horses in the North West of England and North Wales, as well as associations with owner-reported lameness events and hoof abnormalities. Interview questionnaires were conducted on 35 horse owners if their horse(s) met the study criteria of being sound, in work and under the care of one of five named farriers. Data were gathered on 52 horses. Eventing (21.1%) and leisure (21.1%) were the most commonly listed disciplines; dressage accounted for 17.3% (9) and riding/pony club activities 13.5% (8). Seven horses (13.5%) worked in a riding school. Thirtytwo (61.5%) horses were actively competing: 43.8% at local, 34.4% at regional and 21.9% at national level. 84.6% and 71.2% of horses participated in at least one flatwork or hacking session per week respectively. 63.5% (32) jumped and 28.8% were lunged at least once weekly, only 4 horses (7.69%) were exercised regularly using a horse walker. 63.5% of horses were described as in medium work, 25% in hard work and 12% in light work. Seven horses (13.5%) were in lower work intensity than usual due to a previous lameness event. Of those only three horses were competing, and none at a national level. Horses completed a median of 5 exercise sessions per week (IQR 4.5-7), for a median of 60 minutes per session (IQR 30-90 minutes). 34.6% (18) of horses had a previous history of lameness, of which two-thirds (12/18) had occurred >12 months previously, and 27.8% (5/18) had occurred >24 months previous to the questionnaire. 25 horses (48.1%) were reported to have suffered from at least one hoof abnormality. Over 40% of reported abnormalities were hoof imbalance (13/32), and in almost all cases (92.3%, 12/13) this required ongoing treatment. However, 48.6% and 41.7% of horses in medium and hard work, respectively, were reported to have suffered from a hoof abnormality. Leisure horses participate in a range of activities and competition levels. Previous lameness events can impact the level of work and competition they are able to do. Hoof abnormalities are commonly reported, with imbalance being the most prevalent form of abnormality. Ongoing analysis of the ever-expanding dataset will allow identification of risk factors for hoof abnormalities and lameness events.

Lay person message: Pleasure horses may participate in a wide range of activities. Historical lameness can impact on a horse's ability to work to its usual level. Hoof abnormalities are prevalent amongst pleasure horses, with hoof imbalance being the most common problem. Long-term management can enable horses to work at the desired level.

Keywords: lameness; hoof imbalance; training; pleasure horses.

The influence of human handedness and equine laterality in horse–rider combinations and previous injuries on rein tension

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The reins are one of the main means of communication between horses and riders, but little information regarding the influence of human handedness and equine laterality on communication in different horserider-combinations exists. Therefore rein tension was measured in 88 combinations of 57 riders and 78 horses (left-handed (LH)*left-lateral (LL)=9, right-handed (RH)*right-lateral (RL)=33, LH*RL=9, RH*LL=23, RH*without side-preference (NL)=10, ambidextrous (A)*RL=4) in walk, trot and canter on circles and straight lines in clockwise and counter-clockwise directions using a portable rein tension device. The influence of equine laterality (as assessed by riders based on horses' preferred side for dressage tasks), human handedness and previous musculoskeletal injuries in horses and riders on time shift between left and right peaks (TS) based on data recording with 100 Hz and mean (M), standard deviation (SD), peak (P) and mean difference (MD) of rein tension was investigated using mixed-model analysis (F test throughout). The model included equine laterality, rider handedness, their interaction, as well as presence and side of prior injuries as fixed effects and horse, rider and horse*rider interaction as random effects. Localization of previous injuries in horse-rider-combinations was assessed via a questionnaire and evaluated using cross tabulations (chi^2-test). TS was lower in A (0.02±0.1 sec.) and LH (0.03±0.1 sec.) compared to RH (0.05±0.001 sec., p=0.047). TS was not influenced by equine laterality in horse-rider-combinations (p>0.05). With RH, mean tension was higher in the dominant hand (e.g. RH*LL: 9.8±1N left & 10.3±1.4N right, df=6, p<0.0001) and less stable in the dominant hand* horse's non-preferred side (SD: RH*LL: 8.1±0.9N left & 8.3±0.9N right; df=6, p<0.0001). With LH mean tension was higher on the horse's non-preferred side (e.g. LH*RL: 9.3±1N left& 8.7±2N right, df=6, p<0.0001) and less stable on the horse's preferred side (SD: LH*RL: 7.4±1N left & 8.9±1.2N right, df=6, p<0.0001). With horses injured right higher P (30.3±3.1N LH*horses-injuredright vs. 13.7±4.3N LH*horses-injured-left, df=11, p<0.0001) and MD (10.7±1.7N LH*horses-injured-right vs. 6±2.3N LH*horses-injured-left, df=11, p=0.045) occurred, especially combined with LH. Rider-injuries-right and rider-injuries-bilaterally were reported for combinations of RH only. Rider-injuries-left were only reported for combinations with LH and RH*LL (chi^2=4433, df=28, p<0.0001). Injuries in horse-ridercombinations were related to the rider's dominant hand. Rider handedness influenced rein tension symmetry. LH might be less lateralized than RH. Since asymmetric rein tension and cues affect horses' learning and potentially increase risk of injury, the regular control of rein tension during training is advisable.

Lay person message: Equine laterality and human handedness both influenced rein tension. Rider handedness influences symmetry of rein tension and is related to risk of injury in horses and riders. Handedness appears to be less strong in ambidextrous and left-handed riders.

Keywords: rein tension, equine laterality, human handedness, symmetry, risk of injury.

Functional performance evaluation in clinically normal horses but seropositive for equine infectious anemia

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Equine Infectious Anemia is an incurable disease, being endemic in the Brazilian swamp (Pantanal). The objective was to evaluate the physical performance of the seropositive horses (with no disease signs) in order to obtain data to encourage the control of the disease in this area. Sixteen Pantaneiro breed male horses were used, ranging from 10 to 16 years old, 8 being seronegative (G1) and 8 seropositive (G2). None of them had clinical signs of the disease. The groups were kept separate in nearby farms and remained loose in native pasture, with mineral-enriched salt and water ad libitum. Functional performance tests were conducted before and after training. Tests were carried out on a grass flat track with 1,500m. The rider exercised each horse at trot, elongated trot, canter and gallop. During the test, heart rate (HR) and blood lactate (LA) were monitored. Whenever the lactate concentration was >4mmol/L and/or the HR was >150 bpm the test was interrupted. The travel distance (TD) from the start of the test to the point at which it was interrupted was recorded. After that, horses worked every other day for 42 days for 1h at pace, gallop and pace again. Gallop speed was limited when HR reached 70% of the maximum HR recorded in the 1st test. A regression equation was used to estimate the speed at which LA reached 2mmol/L (V2), 3mmol/L (V3) and 4mmol/L (V4). Taking together these results and HR that the groups reached at the end of each stage of the incremental effort test, the performance differences from the 1st to the 2nd tests were evaluated. In the first test, there was no difference between the experimental groups in V2, V3 and V4 and in HR. However, in the test performed after training, G2 presented higher V2, V3 and V4 and higher HR at speeds of 3.5, 4.2, 5.3 and 8.2m/s ($P < 0.05$). In both tests the TD was higher ($P < 0.05$) in G1. Compared with normal horse, infected ones presented reduced performance even after training. Our findings show that Equine Infectious Anemia reduces the functional performance even in horses without clinical signs of the disease. Thinking about work, there is no advantage for the farmers to keep infected horses.

Lay person message: Equine Infectious Anemia is an incurable disease, being endemic in the Brazilian swamp (Pantanal). The objective was to evaluate the physical performance of the seropositive horses (with no disease signs) in order to obtain data to encourage the control of the disease in this area. Functional performance tests were conducted before and after training. Compared with normal horse, infected ones presented reduced performance even after training. Our findings show that Equine Infectious Anemia reduces the functional performance even in horses without clinical signs of the disease. Thinking about work, there is no advantage for the farmers to keep infected horses.

Keywords: equine infectious anemia; performance; equine; lactate.

Piroplasmosis in Italian stadardbred horses: 15 years of surveillance data

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Equine piroplasmosis (EP) is a blood-borne disease caused by *Babesia caballi* and *Theileria equi*. The clinical form causes fever, icterus, and severe anemia. The subclinical form is more difficult to diagnose as the clinical signs are unreliable, therefore laboratory tests are required. The aims of this study were to document the prevalence of subclinical piroplasmosis in poorly performing Standardbred racehorses and to explore associations between subclinical disease and haematological parameters. Blood was collected between 2004 and 2018 for initial screening of poor performance, with haematology and biochemical analyses conducted; blood cell counts using a cell counter analyser, haematocrit (Hct) by centrifugation, biochemical parameters using a photometer, and serum proteins using agarose gel electrophoresis. Blood smears were prepared, coloured with a modified Giemsa, and an experienced technician (RL) identified the presence of protozoa (positive: EP; negative no-EP). Categorical data were presented as numbers, percentages and 95% confidence intervals (CI) and continuous data as medians and interquartile ranges (IQR). Associations between parameters and infection status was established using Wilcoxon-Rank-sum test. The studied population included 519 horses (142 female, 27.6%; CI 23.8% - 31.7%), with a median age of 4 (IQR 3 to 8) years. The prevalence of EP was 9.3% (CI: 6.9% - 12.1%). The median red blood cells was lower in EP than non-EP (7.61 (IQR 6.71-8.71) *vs* 8.67 (IQR 7.89 to 9.52); $p<0.001$) and below the normal range (NR) (8.03-11.10*10^6/µl). Similarly, haemoglobin was lower in EP horses, with a median of 12.05 (IQR 10.9 to 13.5) vs a median of 13.4 (IQR 12.2 to 14.5) in the no-EP horses ($P < 0.001$) (NR: 12.70-15.7 g/dl). The median Hct for EP horses was 32 (IQR 20 to 36) *vs* a median of 37 (IQR 34 to 40) in no-EP horses ($P < 0.001$)(NR: 36-43%). Bilirubinemia was higher in EP *vs* no-EP (median 3.92 (IQR 2.91 to 5.57) *vs* median 2.63 (IQR 2.05 to 3.48); $P < 0.001$). While the α2-serumproteins were lower in EP than in no-EP (median 12.36 (IQR 11.57 to 13.44) vs median 13.3 (IQR 11.95 to 14.72); $P = 0.003$), δ-globulin were higher (median 24.37 (IQR 21.12 to 27.04) vs median 22.60 (IQR 19.74 to 25.50); $P = 0.02$). In Italian Standardbreds, subclinical piroplasmosis caused poor performance, mild normocytic, normochromic anemia, hyperbilirubinaemia and hypergammaglobulinemia. As there were cases with overlap between parameters in EP and no-EP horses, and normal ranges, BCC and other specific laboratory tests (i.e. blood cytology, PCR, ELISA) should be performed to diagnose subclinical EP.

Lay person message: Subclinical piroplasmosis can contribute to poor performance and poor welfare. Accurate diagnostic procedures are required to identify cases of horses suffering from subclinical piroplasmosis to ensure the criteria of "lack of disease" in the principle of good health. Blood tests and blood cytology are essential when a Standardbred is not performing well. However, when blood test results are outside the normal range further laboratory tests should be performed to confirm a diagnosis in the event that the organisms are not seen in the blood, as the disease can still be present under these circumstances.

Keywords: piroplasmosis; haematology; diagnosis; health; welfare.

Altered thoracolumbar position during application of craniocaudal spinal mobilisation in clinically sound leisure horses

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Back pain is a complex condition that can adversely affect equine performance leading to negative economic impact through days lost from training and competition. Exploration of the efficacy of techniques purported to reduce or eliminate back pain in horses could provide horse owners and trainers with the ability to make evidence-informed judgements on how to ensure equine welfare is prioritised. Manual therapy techniques are commonly used by physiotherapists in the management of back pain to restore a pain-free range of motion and function in humans. However, limited research supports the proposed kinematic effects of manual therapy in the horse. This study investigated the kinematic effects of craniocaudal spinal mobilisation (CCSM) on the thoracolumbar (TL) spine in asymptomatic leisure horses used for hacking and unaffiliated competition, assessed and treated by the same experienced veterinary physiotherapist. Markers were fixed to T10, T13, T17, L1, L3, the highest point of the wither and the tuber sacrale on thirteen horses (4 mares; 9 geldings) that were positioned squarely. The CCSM technique consisted of two parts: 1) carpal flexion of either forelimb to 90° to maintain the horse in a tripod position, and, 2) the application of a cranial to caudal force to the forehand via the ipsilateral point of the shoulder. Movement changes of the thoracolumbar markers from baseline to maximum flexion when CCSM was applied was recorded as 'depth' (mm) relative to a fixed line drawn from the tuber sacrale to the maximal point of the withers. The change in angle (°) of each marker relative to the same markers was also recorded. Data were collected via video and analysed with DartfishTM software. The CCSM technique resulted in a significant increase in the mean change of ROM for TL angle of 7° (Wilcoxon: $P < 0.0001$) and a significant decrease in the mean change of ROM for TL depth of 16mm (Wilcoxon: $P < 0.0001$) between baseline and maximum flexion measurements across the cohort, for all markers except for TL angle at L1 (Wilcoxon: $P>0.05$). Between 5-9° of flexion occurred on application of CCSM at T10, with 6-7° at T13, 4° at T17 and 6° at L3 and L5. These results indicate CCSM induced flexion in the thoracolumbar spine, in a region commonly associated with pain and poor performance, supporting its potential to improve range of motion and function in horses. Further studies to understand whether CCSM provides an effective treatment for equine back pain are warranted.

Lay person message: Back pain is a common reason for horses not to be exercised or competed, and for poor performance. In humans, manual therapy is used to treat back pain but the efficacy of such techniques in horses is not known. A common manual therapy technique (CCSM) was applied to horses without back pain (vet/physiotherapist assessed) to measure what effect it had on spinal kinematics. CCSM produced flexion in the thoracolumbar spine suggesting it could be a viable treatment for equine back pain. Further studies to see if the treatment has the same effect in horses with back pain are required.

Keywords: back pain; manual therapy; posture; veterinary physiotherapy; horse; spinal kinematics.

Real–time signal quality index of ECG in horses during submaximal treadmill test

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Horses are one of the best model of athlete therefore a continuous monitoring of the heart rhythm during exercise is crucial for assessing animal's health status and diagnosing of pathologies. Specifically, anomalous heart behaviour could affect performance and also be a potential cause of unexpected collapse or death. The above motivations lead to a quantification of the quality of the recording which is essential for heart status evaluation. In this study, a novel real-time index designed to assess the quality of electrocardiographic (ECG) traces is proposed. It has been applied to a group of horses during a submaximal treadmill test procedure. The group was comprised of 5 Standardbred female horses, aged 3-6 years, weighing 504-569 kg. The exercise protocol consisted in the following phases: Walk 1 (1.7 m/s), Trot 1 (3.5 m/s), Trot 2 (5.5 m/s), Gallop (9.5 m/s). Each horse was equipped with two ECG monitoring systems, which were used simultaneously. The first one was based on textile electrodes and the second one with red-dot electrodes. The textile-based system had an elastic belt fastened around the chest behind the shoulder area of the horse with two textile electrodes. Red-dot electrodes were placed close to the textile ones to acquire the ECG traces in the modified base-apex configuration. Here, we showed a novel statistical index "ksSQI" derived from a combination of the fourth moment (kurtosis) and the third moment (skewness) of the ECG signal. We computed three signal-quality thresholds: Unacceptable (U): ksSQI < 0.5; Acceptable (A): 0.5 < ksSQI < 0.8 and Good (G): ksSQI > 0.8. Results highlighted that textile electrodes were much more robust to movement artefacts with respect to the red-dot showing a significant evidence of their better performance. In fact, the median percentage of red-dot ECG segments belonging to the U (unacceptable) class, was 80% during Trot 2 and became 84% in the last session. Conversely, the median percentage of good quality (G) signal acquired by means of textile electrodes was above 90% in the first three sessions. In the last session, i.e. during gallop, even if the signal quality decreased, textile electrodes showed good performance in the whole session highlighting a robust behaviour against movement artefacts. Moreover, non-parametric Wilcoxon statistical test was used to compare the two acquisition systems in each protocol session. We found that the values of ksSQI were significantly different in all the sessions, with a p-value less than 0.01 (N=10).

Lay person message: Accurate estimation of the ECG signal is essential both to evaluate the health status and to obtain adequate values of Herat Rate Variability (HRV). Moreover, HRV is essential to achieve information on the autonomic nervous system which changes during emotional reaction to humans or environmental stimuli. Signal quality assessment becomes crucial to differentiate movement artefacts (noise) against normal ECG trace. Our data draw attention to two important aspects: the customization of the monitoring system and signal robustness against noise. These aspects lead us to achieve a more detailed description of horse emotional status allowing prompt interventions.

Keywords: wearable system; ECG; textile electrodes; movement artefacts; signal quality; treadmill.

Are humans able to distinguish between positive and negative domestic horse (equus caballus) vocalizations

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Domestic horses exhibit a range of vocalizations produced within a social or non-social context that can be categorized into positive or negative valence indicative of their experience. Some examples of positive vocalizations include reuniting with a herd member or expectation of food rewards, while negative contexts include situations such as mare-foal separation and aggression. Understanding and recognizing the context of vocalizations can give insight into the emotional state of the horse. This study investigated whether humans were able to accurately categorize the valence of vocalizations from the domestic horse. Eight audio clips from each grouping of male, female, mature (over 2 years of age) and immature (less than 2 years of age) horses in known situations were collected from personal videos and open source materials to provide a balanced sample of four positive and four negative vocalizations from each (total of 32 audio clips). One positive and one negative vocalization in each grouping was collected from animated movies and television shows. Using an online survey, participants (n=309; 182 female, 18 male, 109 unknown) were asked to rate the audio samples as positive or negative in context. Participants provided demographic information (age, gender, horse experience (defined by frequency of interaction)). A chi-squared test evaluated the correctness of participant responses to expert ratings, and the influence of demographics on responses. Overall, humans were able to accurately categorize the valence of domestic horse vocalizations 64.4% of the time ($\chi^2$1,6421 = 528.79, P < 0.0001). Gender did play a role in the outcome ($\chi^2$1,5719=4.67, P = 0.031), with women outperforming men (64.8% vs. 59.8% correct responses respectively). Other demographics including age ($\chi^2$1,5747 = 9.29, P = 0.09), and experience ($X^2$1,5747 = 3.48, P = 0.32) appeared to not play a role in an individual's ability to correctly classify horse vocalizations. The subset of vocalizations taken from movies provided similar results. Vocalizations used in animated movies appear to portray the expected desired emotion connected to the scenario, enabling even people inexperienced with horses to understand the emotional context. Positive and negative vocalizations may be indicative of the horse's emotional state, and the ability to accurately interpret these vocal cues enables humans to respond appropriately to varying situations in training, housing, and husbandry practices.

Lay person message: Horses can communicate their emotional state through a range of vocalizations. Here we show that humans can accurately distinguish between vocalizations indicating positive and negative experiences of the horse. Women were significantly better at this skill than men, while age and experience with horses did not influence the ability to categorize horse vocalizations. Understanding the emotional valence of horse vocalizations allows humans to respond appropriately to the situation.

Keywords: vocalization; emotional state; behaviour; human-horse interaction.

Social learning in horses: differs form individual learning only in the learning stimulus and not in the learning mechanisms

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Equine welfare can be enhanced by applying species specific training. This may incorporate social learning, as horses are highly social and social stimuli are of primary importance. Social learning is comparable to individual learning in its learning mechanisms, differing primarily in the way it is stimulated. Our initial study showed that horses of different breeds (N = 38) follow humans after observing other horses doing so, but only if the observed horse was familiar to and higher ranking than the observer (Fisher's exact test: N = 12, P = 0.003). A second study showed that horses and ponies (N = 25) learned to pull a rope to open a feeding apparatus after observing demonstrations by conspecifics, again, only if the demonstrating horse was older and higher ranking than the observer (Fisher's combination test, N = 3, v2 = 27.71, P = 0.006). Our third approach showed that horses and ponies (N = 24) learned to press a switch to open a feeding apparatus after observing a familiar person (GzLM: N = 24, z = 2.33, P = 0.02). Most recently, we confronted horses and ponies (N = 50) with persons demonstrating different techniques for opening a feeding apparatus. In this study we investigated whether the horses would copy the demonstrators' techniques or apply their own. Here only some horses copied the technique, and most of the successful learners used their mouths irrespective of the demonstrators' postures (Chi Square Test: N = 40, df = 2, $\chi 2$ = 31.4, P < 0.001). In all the approaches social stimuli elicited learning processes in the test horses, while only a few individuals in the control groups mastered the tasks by individual learning. The following behaviour observed in the initial study may have been facilitated by a social stimuli (social facilitation), and the opening of the feed boxes in the subsequent studies appear to be mostly the result of enhancement (social enhancement). Some horses may have used the social stimuli at first and continued their learning process by individual trial and error. However, the horses were also selective in whom and some in how to copy. This may have been conditioned (socially conditioned) or the result of simple forms of reasoning on the reliability of the particular information provided by demonstrators of certain social ranks or social positions, as high ranking and familiar horses and familiar persons were copied and some imitated exactly.

Lay person message: Traditional riding instructions suggest that horses learn by observing other horses. For example, older, more experienced driving horses are used for initial training of young driving horses. We have shown that horses indeed use learning stimuli provided by other horse, as well as by humans. Horses readily accept stimuli observed in high ranking and familiar horses, and familiar persons. Such stimuli elicit learning processes which are comparable to individual learning. We suggest applying social learning whenever possible, as it is much faster and less stressful than individual learning, where learners experience negative outcomes in trial and error learning.

Keywords: horse; individual; learning; social.

Multisensory exploration of mirror images in horses

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Mirrors have been used to simulate social interactions in a variety of species. Being able to present social stimuli in a controlled way can be valuable for research and as enrichment for captive animals. There is dramatic variation in how different species respond to mirrors. Some animals show curiosity, aggression, and/or fear, suggesting that the mirror image is perceived as an unfamiliar conspecific. In a subset of tested species, after some experience individuals appear to respond to the mirror as though it were their own reflection, suggesting a level of self-awareness. In order to make use of mirrors for either research or enrichment purposes, it is critical that we understand how a particular species reacts to their mirror image. In the current study, we presented a 1x1 m mirror to 26 adult horses. In the first phase, we presented the mirror and recorded the time spent inspecting the mirror with each eye, sniffing at the mirror with each nostril and touching the mirror with each side of the face over a 15-minute period. We found that horses did not show any directional bias when inspecting the mirror (Wilcoxon Signed Ranks tests, N = 25: visual = -0.65, P = 0.52; olfactory = -1.02, p = 0.31; tactile = 0.93, P = 0.35). In the second phase of the study, we applied a mark to a randomly selected side of each horse's face using yellow tape and a sham mark using transparent tape on the other side. We then observed each horse interacting with the mirror for another 15 minutes, recording the amount of time looking at, sniffing and touching the mirror on each side of the face. We found that horses spent significantly more time observing the mirror with the eye (WSR = -4.29, N = 25, P < 0.001), sniffing with the nostril (WSR = -3.88, N = 25, P < 0.001) and touching the mirror on the marked side of their face (WSR = -3.77, N = 25, P < 0.001). These results indicate that horses are interested in their mirror images and direct their investigation toward the foreign mark on their face, potentially suggesting that the horses could be capable of mirror self-recognition, though additional confirmation is required. Measuring multisensory responses toward mirrors may be a useful tool for understanding selfrecognition in species that lack the anatomical features or dexterity to interact physically with an unseen mark.

Lay person message: Horses investigate their own image in a mirror using sight, smell and touch. Horses appear to be interested in coloured marks on their own faces which they cannot see without a mirror. These results could suggest that horses can recognize themselves in a mirror. Studying how horses respond to mirrors may help us to understand the mind of the horse and mirrors may have value for social enrichment.

Key words: self-recognition; social behaviour; mark test; horse.

Effect of three magnesium based feed supplements on inferred measures of dopamine activity and cognition: a pilot study

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Despite their widespread use throughout the equestrian industry, the behavioural effects of magnesium based feed supplements (calmers) have not been rigorously tested. The aim of this exploratory investigation was to measure the effects of 3 magnesium based calmers on inferred measures of dopamine transmission and cognition. An initial process of component scoring of temperament questionnaire data was undertaken to determine the four most behaviourally reactive animals from a cohort of 20. A 4x4 blinded Latin square design was applied to the four animals, which were fed (in randomised order) a limestone flour based placebo plus 3 experimental calmers containing identical magnesium concentrations with the addition of either St John's wort (*Hypericum perforatum* [Hp]), Chia Seeds (*Salvia hispanica* [Sh]) or a proprietary blend of species from the *Saxiflagares* (S) family. Each of four study phases featured a two week loading period (75g treatment / placebo / day) followed by a one week maintenance period (50g treatment / placebo / day) after which data collection commenced. Spontaneous Blink Rate (SBR) and Behavioural Initiation Rate (BIR) have recently been validated in horses as inferred measures of dopamine (a neurotransmitter linked to hyperactivity and stress) and thus these measurements were applied at the end of each phase for 30 minutes on three separate occasions, whilst the Go/No-Go cognitive task was utilised as a measurement of impulsivity and response inhibition. Following the end of data collection for a particular phase, a two week 'washout' period was instigated during which no calmer or placebo was administered. Analysis via repeated measures ANOVA revealed a significant overall difference in SBR between treatments ($F = 4.696$, $P < 0.01$) although the only comparison which retained significance following Post-hoc testing (Tukeys Honest Significance Test) was a reduction in SBR for horses on the Sh compared to the Hp formulation ($P < 0.01$). In addition, the number of incorrect No-Go responses differed significantly between treatments ($F = 3.433$, $P < 0.05$) although the only notable post-hoc finding was a trend approaching significance ($P = 0.054$) towards a reduction in S versus the placebo. No additional treatment related notable/significant differences were observed. The findings of this initial investigation suggest that when utilised in tandem with magnesium, administration of Sh might reduce dopamine transmission and S has the potential to reduce inappropriate responding, paving the way for further testing of these components on unmanageable behaviour and trainability of the ridden horse.

Lay person message: Calming feed supplements containing magnesium as their primary ingredient are often fed to horses although little is known about their efficacy. In this study, magnesium when blended with botanical additives, altered indicators of brain activity associated with hyperactivity and stress, and there was evidence of reduced inappropriate responding which could lead to a more trainable disposition in the ridden horse.

Keywords: magnesium; dopamine; blink rate; hyperactivity; stress.

Could the divided attention be considered a referential gesture?

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The impossible task (IT) paradigm is typically used in animal cognition research to analyse referential communication between animals and humans. It provides insight into the decision-making processes under an expectancy violation. We tested 18-stable horses (15.2±4.5 years) in five consecutive phases. Two familiar men and one unfamiliar woman were used. In P1 two people (familiar and unfamiliar) stood motionless on the two opposite sides of a table outside the horse's usual box (to verify the horse's response to the experimental setting in the absence of food). In PS1, while people remained in the same position, a carrot was placed on the table (repeated thrice), to teach horses that food was easily reachable. In P2 the carrot was placed on the table out of horse's reach, while people remained in the same position, to evaluate the horse's behaviour during the expectancy violation. PS1 and P2 were repeated in absence of people (labelled respectively PS2 and P3). Each phase lasted one minute, except for PS1 and PS2 which had a variable duration and were not used in the analysis. The ethogram included the olfactory exploration and tactile interaction toward table and people, the frustration behaviours and the direction of the horse's ears, as an indicator of the attentional state in terms of selective (both ears directed at the same target) and divided attention (each ear directed simultaneously at two different targets). The repeated-measures Friedman test with a Wilcoxon post-hoc test (Bonferroni corrected) was used to compare horse's behaviours during P1, P2 and P3. Results revealed that horses spent less time (seconds) exploring the table in P1, while they did it more in P2 (Median P1=0, P2=7.5, P3=3.5; χ^2=22.58, df=2, P<0.001; P1vsP2 W=153 P<0.001; P1vsP3 W=129 P=0.002; P2vsP3 W=164 P<0.001). Horses spent less time interacting with the table (Median P1=0, P2=2.5, P3=2; χ^2=9.02, df=2, P=0.002; P1vsP2 W=104 P<0.001) and making selective attention toward it (Median P1=2.5, P2=9.3, P3=5.1; χ^2=12.33, df=2, P=0.002; P1vsP2 W=169 P<0.001) during P1 rather than P2. The divided attention table-people has been expressed longer during P2 (Median P1=7.1, P2=14, P3=6.8; χ^2=18.11, df=2, P<0.001; P2vsP1 W=171 P<0.001; P2vsP3 W=152 P=0.006). No differences were found for the behaviours relating exclusively to the people and frustration behaviours. The simultaneous presence of people and food generate a greater interest of the horses toward the table, also with a noticeable increase in the divided attention. This opens the possibility of considering for the first time the divided attention as a referential communication channel that horses use for seeking human help. Nevertheless, future research will have to study in deep this hypothesis.

Lay person message: The way in which the horse asks for human help is still unclear. This test can be a useful tool to understand how horses try to attract human attention when they are in difficulty in a restricted environment. This is a typical situation for horses living in stables or that are usually tied between two poles when they are managed. Knowing the horse's communication mechanisms is essential for the welfare of this animal.

Keywords: impossible task; horse-human communication; helping request; attentional state.

Measuring the nutritional contents of forage form different UK farmers and the potential impact on equine welfare

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The domestic horse (*Equus caballus*) has evolved over millions of years behaviourally and physically to become the trickle feeding grazer that it is today. Due to an increase in high calorific diets, coupled with a decreased level of exercise, equine obesity has become a growing problem within the UK. Obesity has also proven to increase the risk of nutritional related disorders such as; Equine Metabolic Syndrome and laminitis. The gastrointestinal system of a horse and subsequent links to the overall wellbeing of the horse still require investigation, more so now than ever as management within the equine industry does not reflect the natural behaviours of the horse. This study focuses on the importance of testing forages for nutritional content in order to adjust ration formulation, behaviour and health and wellbeing in equines. Data from 2427 UK forage samples, sent for independent testing, were collected and processed to provide mean dry matter, crude protein and soluble carbohydrate content values for each English county. Mean dry matter value was 81.18%DM (Min: 72.64%DM, Max: 92.45%DM). Mean crude protein value was 11.09%CP (Min: 8.96%CP, Max: 19.31%CP). Mean soluble carbohydrate value were 9.73%SC (Min: 9.07%SC, Max: 10.76%SC). The results showed that there was a statistically significant difference amongst UK counties in regards to dry matter ($DF=39$; $H=504.94$; $P<0.001$), crude protein ($DF=39$; $H=518.52$; $P<0.001$) and soluble carbohydrate ($DF=39$; $H=364.17$; $P<0.001$) using a Kruskal-Wallis statistics test. These results highlight the importance of forage nutrition testing as the results showed that county mean values were highly varied. In the future, the equine industry needs to implement the testing of forage within normal management practices, this will improve overall nutritional welfare for equines in the UK.

Lay person message: Accurate analysis of calorific intake for horses must be carried out to ensure the correct nutritional requirements are met and avoid the development of nutritional related disorders. Over 2000 forage samples were collected from independent farmers, these samples were then processed to provide mean dry matter, crude protein and soluble carbohydrate content values. There was a statistically significant difference in the soluble carbohydrate, crude protein and dry matter levels depending on the UK county the sample had been obtained from. Future analysis needs to focus on the incidence rates of owner reported nutritional disorders and the correlation between forage content.

Keywords: nutrition; diet; obesity; welfare; forage analysis; equine.

Does the presence of a smart grazing wall pod affect the time budgets of a stabled horse?

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Domestication of Equus caballus and current husbandry practices have led to a notable increase in observed stereotypic behaviours in the performance horse in comparison to their feral counterparts. The stabled horse spends less time grazing and browsing within their daily time budgets compared to the horse who is granted access to pasture and field turnout. This decreased amount of time foraging can have serious detrimental impacts on the horse's physiological and psychological wellbeing; increasing the risk of Equine Gastric Ulcer Syndrome and increased risk of stereotypic behaviour development. Ten horses on a combined stable and turnout system, mean age 12 years ± 2.4 of mix breeds (TB, TB x, Connemara and Welsh Section D) were involved in the study. Each horse was stabled for a period of an hour; thirty minutes of which the horse had access to hay net and thirty minutes in which the hay net was removed and the SGWP added to the stable. Utilising an equine ethogram, the amount of time carrying out specific behaviours was recorded over the study period. The trial was then repeated a further two times. There was a statistically significant difference in the amount of time spent eating before and after the addition of the SGWP (Wilcoxon = 55.0, p = < 0.05). There was no statistically significant difference in the amount of time spent drinking before and after the addition of the SGWP (Wilcoxon = 10.0, P = 0.294). There was a statistically significant difference in the amount of time spent resting/stood still before and after the addition of the SGWP (Wilcoxon = 1.0, P = 0.006). There was no statistically significant difference in the amount of time spent moving around the stable before and after the addition of the SGWP (Wilcoxon = 30.0, P = 0.838). The initial trial of the SGWP has enabled the identification of factors to be implemented for further development. Further research into the SGWP as a form of stable enrichment is essential to promote equine welfare in regards to prevention of the development of stereotypic behaviours and promote good health.

Lay person message: Providing enrichment for the stabled horse is a way of ensuring good welfare, and to decrease the likelihood of the development of stereotypic behaviours and promote health. A newly designed Smart Grazing Wall Pod has been initially trialled in ten stabled horses to assess its effect on their time budgets. It was found that the Smart Grazing Wall Pod was utilised by all horses and a statistically significant difference in the amounts of time carrying out specific behaviours was affected.

Keywords: time budgets; enrichment; stereotypic behaviour; welfare; feeding.

Evaluating the ability of the Orscana sensor to monitor stabled horse activity

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Technological devices to automatically detect and classify equine activity are appearing on the commercial market, and may provide a convenient way for owners to continuously monitor a horse's health and welfare through evaluation of their time-budget. However, the accuracy and reliability of these devices must first be established. This study aims to evaluate the ability of the commercially available Orscana Sensor to detect and categorise equine activity using accelerometry and an internal gyroscope. A sample of mature horses (n=6) (mean weight = 544±90 (SD) Kg) from a college herd were housed in individual stables measuring 3x3m with rubber flooring for 24 hours. All horses were provided with hard feed simultaneously at 15:00 h on day one, and 11:00 h on day two, and had free access to automatic water drinkers and *ad libitum* hay for the duration. Two methods were used to monitor their activity, a) the Orscana devices were secured to the rug worn by each horse, located in the hollow area below the hip on the left side, and set to detect and categorise activity as either 'Calm', 'Active', 'Disturbed', or 'Lying'; b) infrared stable cameras recorded all horse activity, with the corresponding video footage assessed using Observer XT software (Version 7.0, Noldus Information Technology). Horse movements were first categorised into individual behaviours based on a previously developed ethogram, with each behaviour then being further classified into one of the four activity groups recognised by the sensor. This enabled comparison between the results of both methods, with the visual observations used as a reference in this study. Kendall's Tau (τ) were run to assess the level of agreement between both methods, and showed that the sensor was able to detect both 'Active' (τ=0.7, Z=4.8, P<0.001) and 'Lying' (τ=0.7, Z=4.7, P<0.001) activity with a 'good' level of accuracy. Its ability to detect 'Calm' activity was considered 'Moderate' (τ=0.5, Z=3.4, P=0.0007), and no significant agreement was seen between the measures for 'Disturbed' activity (τ=0.3, Z=4.7, P=0.1042). These results do evidence a relationship between the two measures, although it should also be considered that agreement will vary depending on how behaviours from the ethogram are classified into the four activity groups, and therefore warrants further investigation if activity monitoring devices are to be used as reliable research tools. These findings suggest that this device is suitable for use by horse owners when monitoring changes in activity level is the aim.

Lay person message: The Orscana Sensor is a commercially available device marketed to monitor horse activity, although an independent validation is required to ensure it meets these advertised claims. Six stabled horses wore the sensor for 24 hours, during which time their activity was also visually monitored for use as a reference method. The results indicate that this device can detect 'calm', 'active' and 'lying' based activity with a good level of accuracy. It is therefore considered suitable to monitor stabled horses when changes in activity level are of interest, which could aid in the detection of ill health, pain, or compromised welfare.

Keywords: technology; validation; activity monitoring; accelerometry; stable.

Relationship between equine metabolic syndrome and feeding practices

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The combination of decreased work expectations, improved forage qualities, increased feedstuff provision and husbandry measures to limit energy losses through thermoregulatory demands have served to promote the maintenance of positive energy balance in horses and ponies for leisure purposes. These management practices have caused an increase in the incidence of equine obesity, which is a major risk factor for insulin dysregulation and the resultant laminitis, condition known as equine metabolic syndrome (EMS). However, the development of EMS could also be influenced by genetic components. The aim of this report is to investigate the possible relationship between the concentrations of non-structural carbohydrates (NSC) in forages and the development of EMS in horses. A retrospective observational study was carried out in a population of 14 group-housed horses, which included 3 mares and 11 geldings, fed with oat hay *ad libitum* for 3 years. All horses were in maintenance level of workload. Breeds varied, with a predominance of Andalusian and derivatives. A complete physical examination was performed and blood insulin basal concentrations were measured following 8 hours of fasting. The concentration of NSC in the oat hay was estimated applying proximate analysis and anthrone method. Of the 14 horses included in the study, 11 had a body condition score (BCS) of 7 or more out of 9; and 4 of them showed hoof changes, such as divergent growth rings and dropped soles, indicative of chronic laminitis. The rest of the examination was unremarkable. Concentrations of insulin were above the reference range (>20μIU/mL) in 5/14 horses, suggesting the presence of insulin dysregulation. These 5 horses were diagnosed with EMS. The NSC concentration in the oat hay was estimated to be 21%, which is considered a high level of NSC, especially for those horses genetically predisposed to suffer EMS, such as Andalusian horses. Data revealed a high incidence of obesity (78,57%), insulin dysregulation (35,71%) and chronic laminitis (28,57%). In summary, our results support the idea of the contribution of NSC over-feeding to the development of obesity and EMS, besides the influence of genetics. So far, it would be necessary to follow up the study in a larger population, in order to establish statistical correlation. Ideally, the NSC content of the forage should be determined and the diet should be tailoring to the individual needs of the horse.

Lay person message: Nutritional management is strongly recommended to be included as a routine element of normal equine husbandry, in order to maintain an adequate BCS and athletic performance, and prevent the development of metabolic disorders, such as EMS and the potentially life-threating laminitis. Treatment of laminitis would be difficult; prevention could be easier.

Keywords: nutrition; obesity; laminitis; insulin; equine metabolic syndrome.

Health and body condition in riding school horses housed in groups or traditional box/tie stall housing

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An increasing number of horses are housed in loose housing in groups. We aimed to find out if welfare of Swedish riding school (RS) horses differed between housing systems. RSs with horses in loose/group housing (n=8) were compared with RSs with the horses housed in tie stalls or boxes (n=8). Retrospective health data 6 months back was collected from the RS journals/notes. A horse veterinarian and an agronomist, specialized in horse feeding, examined 10 horses (8 in one RS) per RS. Health conditions (e.g. skin lesions, lesions in the corners of the mouth, pain, fever, rashes, lameness etc) and body condition score (BCS) using the Henneke scale was registered and housing and management routines collected (health check routines, feeding, work load on horses, time outside, de-worming routines etc.). Data was collected in the wintertime when horse welfare is most at risk. A total of 158 horses were examined and we found 207 conditions in these horses. The most common finding was minor skin injuries located where the tack equipment, i.e. saddle and bridle including bit) is applied. This tended to be more common in horses housed in tie stalls/boxes (means ±SEM 1.8 ±0.6 and 0.5 ±0.3, ANOVA GLM F=3.14, P=0.09). Colic (within the last 6 months) was significantly more prevalent in RSs with tie stalls/boxes (tie stall/box 2.38 ±0.62, loose/group 0.38 ±0.26 respectively) F=8.62, P=0.01. The tie stall/box horses spent more hours/day immobile (tie stall/box 17 ±0.4, loose/group 3.8 ±0.9). Furthermore none of the box/tie stall horses had access to water in the fields during the winter, whereas all loose/group housed horses did. BCS did not vary significantly between systems (tie stall/box 6.2 ±0.1, loose/group 6.3 ±0.1), however on average the horses had a BCS above what is considered as optimal (BSC 5). In conclusion we found that Swedish RS horses are generally in good health, however even healthier when loose housed. Furthermore, high BSC is a general health risk in Swedish RS horses and all RS would benefit from having an independent feed advisor performing regular body condition scoring of all horses and giving advice on feeding regimes.

Lay person message: We compared health and body condition of riding school horses in loose housing and tie stalls/boxes. In 158 horses we found 207 health conditions. Tie stall/box horses tended to have more small skin lesions at the saddle position and in corners of the mouths. Tie/stall box horses had more colic, which could depend either on less movement and/or not having the same access to water as loose housed horses. Most horses, in both housing systems, were above optimal weight. We conclude that loose housed riding school horses have a better health and that all horses would benefit from independent feed advice to reduce overweight.

Keywords: welfare; riding school; housing system; management; colic.

Injuries of horses housed in box and individually or in groups outdoors vs active open barn

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Horses in Sweden are often kept in individual boxes and in paddocks individually or in smaller groups. There is an increasing interest in housing horses in larger groups in open barns to allow social interaction and movement. The aim of this study was to compare the frequency and character of injuries among horses stabled in different housing systems at the Swedish National Equine Centre Strömsholm. A retrospective study was conducted on 90 warm-blooded riding horses, geldings and mares, ridden and handled by equine students. Data was collected during two seasons: September 2011 - May 2012 and September 2014 - May 2015. The first season, 38 horses were housed in individual boxes and individually in paddock. During the second season, 52 horses were housed in three systems: Active open barn (one group of 21 geldings); Individual box and 2-4 horses in paddocks daytime (21 horses); Individual box and paddock (10 horses). The horses were kept in same sex groups. The data were analysed using Chi^2. The injuries were categorized as follow: kicked by other horse – needing stitches or bandage; kicked by other horse – causing swelling, soreness; lameness – treated with rest; lameness – treated with joint injection; wound - unknown reason; self-inflicted injury – i.e. spikes for horseshoes; injury from stable equipment – i.e. jammed in automatic feeder. Totally 98 injuries were recorded and they were distributed as follow: 45 injuries among 21 horses in active open barn; 39 injuries among 21 horses kept in small groups daytime and 36 injuries among 48 horses kept individually. There were 55 horses noted for all injuries, of which ten were accounted for four or five injuries. There was a significantly higher frequency of injuries ($P>0.001$, $Chi^2=26.21$, d.f.=2) for horses kept in groups whole or parts of the day compared to horses kept individually. No differences were found regarding character of injury between housing system. Keeping horses in groups seemed to increase the risk for injury, and in this study the risk did not differ between small groups outdoors and active group housing. To try reducing the individual variation, horses by the same breed and handling were used. In conclusion, keeping horses in groups is desirable as social interaction and free movement is important for horse's welfare. However, the higher risk of injury needs to be considered. Further investigation is important to learn how to keep horses in groups with a minimal risk of risk of injury.

Lay person message: Social interaction is important for the horse's welfare but keeping horses in groups is a risk for injury compared to keeping horses individually. A study during two seasons on horses kept in an active open barn, boxes and individually outdoors or in small groups showed a higher frequency of injury for horses kept in groups. The risk of injury was the same for horses in open barn as in small group in paddocks. Further studies are important for learning how to keep horses in groups with a minimal risk of injury.

Keywords: injuries; welfare; outdoor grouping, social interaction.

Evaluation of a novel system of linear scoring and automatic ranking of American quarter horses at breed shows

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Judging horse's conformation, gaits and personality at breed shows is one of the main tools applied by breeding associations to improve the next generation's quality and performance. The study compared results of the traditional horse judging system (T) using subjective grades (0-10 with 10 being excellent) to a novel system of linear scoring (LS). LS consisted of 57 single traits (scale -3 to +3) commonly regarded in T. Furthermore an application ("Breed Show App") was developed, that uses a calculation method based on weighting factors for each trait (assigned according to importance to equine health and performance in relation to other traits) to evaluate the horse's quality in relation to the total breeding aim. Results were stated as a total grade (TG) in percent. A total of 1909 American Quarter Horses were judged at regular breed shows with either T during 2012 - 2014 (foals (F=628), adults (A=255)) or LS during 2015 – 2017 (F=768, A=258). To ease comparison between systems, both were converted to percentage scale. Mixedmodel analysis (F test throughout) and Pearson correlations were used. Mean TG was slightly higher in T (83.3±0.2%) compared to LS (81.7±0.3, $p<0.0001$). Mean TG differed for F and A between, but hardly within systems (T: F:83.5±0.3% (a) vs. A:83±0.3% (a); LS: F:80.7±0.3% (b) vs. A:80.8±0.3% (b); a, b: $p=0.001$). Range of grades, however, was larger with LS than for T for TG (28.7±0.3% vs.12.2±0.2%) as well as for all individual categories (e.g. "movement": 38.8±0.6% vs. 22.2±0.5%, "type": 15.8±0.3% vs. 47.8±0.3%, all $p<0.0001$). Mean overall grades of "type" (T:84.9±0.4% vs. LS:81±0.5%, $p<0.0001$), "frame/exterior" (T:84±0.3% vs. LS:82.6±0.4%, $p=0.004$) and "movement" (T:83.5±0.5% vs. LS:79±0.7%, $p<0.0001$), but not of "limbs" and "structural correctness" ($p>0.05$), differed significantly between systems. High TG were correlated with high overall grades "frame/exterior" ($r=0.7$), "type" ($r=0.6$) and "limbs" ($r=0.6$, all $p<0.0001$). The traits and calculation applied with LS are comparable to the traditional system. Evaluation with LS and automatic ranking with the Breed Show App seems to enhance objectiveness of horse judging especially with more complex traits. Grades show a wider range with LS, thus better reflecting phenotypic variance and improving comparability between horses without affecting overall horse ranking and thresholds for licensing minimum standards.

Lay person message: Linear scoring enables judges to evaluate horses more objectively in relation to stating the quality of the horse in relation to the breeding aim with subjective grades. An application was developed allowing automatic ranking of horses based on weights assigned to each evaluated trait. Evaluations can be compared more easily.

Keywords: linear scoring; breed shows; evaluation; American Quarter Horses; horse judging.

Welfare benefits following the implementation of slow feeder hay bags for stabled horses

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With the hypothesis that increasing forage consumption time can produce improvements in welfare, the objective was to verify the effect of the implementation of a slow feeder hay bag (45 mm openings) on the ethogram (24-hour observation using infrared cameras), the motor activity (pedometers), the heart rate (remote monitor), and the cortisol circadian rhythm (RCC) of stabled horses. Eight healthy horses were kept exclusively in individual stalls being fed with pelleted feed, alfalfa hay and Tifton hay (0,62% dry matter of forage/kg body weight). Horses were evaluated before and 8 days after the implementation of the bag. The effect of time over variables was verified by paired Student's t or Wilcoxon tests ($P < 0.05$). Hay bag implementation increased alfalfa ingestion time on 93% ($P = 0.008$). At the end of the study, two of five horses stopped with coprophagy and the mean (± SD) time performing abnormal behaviour (stereotypies and coprophagy) decreased from 131.6 (± 167) to 77.9 (± 132) minutes ($P = 0.0009$). The mean RCC variation increased from 24% (± 24) to 58% (± 8) ($P = 0.002$), with an incidence of 5 horses with abnormal RCC at baseline and none at the end of the experiment. The motor activity was reduced from 577 (± 109) to 331 (± 155) steps per day ($P = 0.02$). In conclusion, the adoption of a slow feeder bag, an available and low cost device, was effective in improving welfare in stabled horses by normalizing the circadian rhythm of cortisol, reducing abnormal behaviours, and reducing their motor activity.

Lay person message: Equine confinement predisposes the development of chronic stress that lead to colic and stable vices, like stool eating and stereotypies. The use of the slow feeder hay bag, which mimics natural grazing and increases the ingestion time was efficient in reducing stereotyped movements and faeces ingestion. Slow feeder hay bag implementation also reduced the motor activity and regularized the cortisol circadian rhythm. Our findings indicate the implementation of this simple and low-cost device can improve in a significant way welfare of horses kept mostly in stall confinement.

Keywords: behaviour; chronic stress; confinement; equine; stereotypy.

The persistent effects of training at weaning in female Lusitano horses

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Most studies developed in the past, intending to determine the effects of early training, did not consider the behavioural consistency along time. Recently, our group assessed that handling at weaning improves trainability and relationship with humans, in yearling foals. In this study, we aimed to determine the effects of training at weaning and its persistence. Female Lusitano foals (n=18) with 7 ± 1 months old were divided into two groups: one submitted to 12-sessions training schedule (ET) once a week, starting at weaning; and another left undisturbed (Control). One week after ET procedure ended, all foals were submitted to veterinary procedures (blood sample collection and deworming *plus* forced restraint); after what they were evaluated in an unfamiliar environment and forced to human presence (Emotivity test). Two years later, after a 2-year period of lack of human touch, all three-year-old foals were subjected to 13-sessions of training and riding, three times a week. Our data showed short and long-term effects of early training in foals' relationship to trainers and anxiogenic situations. When tested, at one year old, differences were found between groups in their reaction to isolation, to approach and to halter (Mann-Whitney U tests, with $p<0.05$ for all variables) with ET foals displaying lower reactivity. At three years-old, in the first days of observing the foals in their new home boxes, differences between the groups were seen, when approached and contacted by their trainer. Although no statistical difference was assessed on the first day, during the next 5 the ET foals tolerated better the trainer's approach ($P=0.022$), the contact ($P=0.018$) and harness ($p=0.035$) and displayed significantly less undesirable behaviours towards them ($P=0.029$), than Controls. Also, learning performance (while being led in hand, and ridden) improved in ET foals, and from the second session differences appear, with the early trained foals exhibiting better gaits regularity ($U=14.0$, $P=0.036$) and being easier to be led while ridden ($U=8.5$, $P=0.006$). Although learning ability at one-year old was not correlated with the 3-years old performance (1 year *vs.* 3 years old, Kendall's tau test, $r=0.38$), tolerance to human approach in unknown environments was positively correlated ($r=0.713$*). Concluding, our data suggest, that training at weaning may be a good predictor of social and learning competences. It may also be a good practice to positively influence the horses' behaviour throughout their lives, potentially reducing risks of injuries at adulthood and improve their welfare.

Lay person message: Nowadays is well known that, in horses, early training improves trainability and human-horse relationship. However less is known about its effects throughout lifetime. We studied female foals that were submitted to training at weaning and compared with an undisturbed group. After two years of no human contact, all young mares were trained and ridden. Different responses to train and to humans were evidenced, with early trained foals being easier to be led in hand and ridden, with improved relationship with trainers, suggesting that training at weaning may be a good practice to positively influence horse's behaviours until adulthood.

Keywords: early training, human-horse relationship, behavioural consistency in horses, emotional reactivity.

Preliminary investigation into the impact of different food restriction practices, each implemented over four days, on equine behaviour and welfare

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Domestic horses may require their access to grass restricted to prevent health issues and maintain a healthy body weight. Many owners are becoming more proactive in the management of their horses' health status by restricting grazing opportunities when grass is too plentiful. Common methods include using grazing muzzles during turn out to limit the amount of grass ingested and stabling to reduce time spent out on grass. Both management practices affect horses' ability to engage in natural behaviour yet have received little attention from a welfare perspective. By using these methods to optimise equine physical health, their mental health may be compromised. The aim of this preliminary study was to investigate whether the use of grazing muzzles and stabling have an impact on equine time budgets and behaviour. Seven adult leisure horses were each observed in three conditions: free-grazing turnout (baseline), turnout wearing a muzzle, and stabling. Subjects were exposed to test conditions (muzzling and stabling) for four days to see if there was any evidence of habituation. Horses were turned out with their usual social groups in baseline and muzzle conditions but stabled individually. A broad ethogram was used as it was unknown which behaviours would be affected; some behaviours were grouped into categories including eating, locomotor, maintenance and repetitive behaviours. Friedman's tests were used to compare percentage of time behaviours were performed between the baseline and test conditions. Increased behavioural signs of distress were observed in both muzzle (head shaking: $x2=12.491$, $P=0.014$; pawing: $x2= 10.933$, $P=0.027$) and stable conditions (pacing: $x2= 19.656$, $P=0.001$) compared with baseline measurements. Least time was spent eating while muzzled, while instead horses spent more time standing alert. Horses did not appear to habituate, with no significant difference in stress related behaviours performed between the first and fourth days. Due to the large impact of individual differences neither method was clearly better in terms of welfare. The method that promotes best welfare is likely to vary between individuals. However, both methods have the potential to cause distress and should be implemented with care. Time constraints meant test conditions were only carried out short term, therefore horses experienced an abrupt change in management, future studies should be carried out where these methods are introduced slowly. This preliminary investigation is one of the few studies that has specifically evaluated welfare implications associated with grazing muzzles and findings will be used to inform future research in this area.

Lay person message: To promote equine health and maintain an appropriate body weight many horses have to have their access to grass restricted. Common methods employed to do this are the use of grazing muzzles while horses are turned out, or keeping horses off grass completely by stabling them. Behavioural signs of distress were observed using both of these methods compared to when horses were allowed to graze freely. The findings suggest that there are welfare implications of both methods of restricting grass intake, although there was a large amount of individual variation between horses.

Keywords: behaviour; food restriction; grazing muzzle; obesity; stabling; welfare.

Digitalization in equine management – perspectives of data usage in group housing system

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While a broad range of digital applications are currently offered for agricultural businesses and digital transformation receives high attention in agriculture with new frameworks such as "smart farming" and "Agriculture 4.0" arising, only a low degree of digital applications can be identified in equine businesses. Based on a survey design, the research study deals with the issue of digitalization in stud farms and gives answers to the question why digital potentials are insufficiently used in group housing systems. The main subject of the analysis were active stables with computer-controlled feeding stations, where concentrated feed and/or hay is automatically dispensed on an individualized rationing several times a day to each horse. Thereby, the automated feeder station is controlled by a feeding computer and the access regulated by a RFID transponder. Active stable owners in Germany were asked about the usage of the digital possibilities, user-friendliness of the feeding computer and stable relevant information on e.g. group size. The main results of the research substantiate the argument, that the uptake of digital applications is mainly for feeding procedures, while other data-driven fields (e.g. health monitoring) are considered potentially useful by managers, yet not entailing a relevant added value for the business and are therefore rarely applied. More so, the analysis revealed, that most computer-controlled feeding stations are not connected to the owners' computer (Binomial Test: N=87, P=0.006) and leading to the solid assumption that the further usage of the data are not foreseen. While at the same time feeding data are evaluated daily by the stable owners to control the feeding access of the horses (Binomial Test: N=87, P<0.001). As the research considered various relevant aspects the role of the user was also considered. Thereby, the analysis showed that there is a strong positive correlation between the functions and user-friendliness of the feeding computer (Spearman correlations: N=87, rs=0.595, P<0.001) but further interest to expand the digital usage is not considered. It can be presumed that other aspects of building an active stable are predominant over the potentials of the digital possibilities given by the computer-controlled feeding station. While the market for active stables is growing in Germany, the degree of digitalization is low. Important to this current state is a lack of knowledge of the usability of existing systems.

Lay person message: Group housing systems for horses are a growing market in Germany. So-called active stables with a computer-controlled feeding station provide regular access for the horse to concentrated feed and hay. Digital applications offered by the computerized feeding stations are only used to evaluate the daily feeding access of the horses, but other data-driven fields as e.g. health monitoring are rarely applied. It can be argued that while there is a clear demand for more usage of digital applications, the insufficient use of the digital possibilities is due the lack of knowledge in their practicability.

Keywords: digitalization; smart farming; computer-controlled feeding station; equine management; group housing systems; digital application.

Competition careers in Icelandic sport horses: duration, reasons for termination and relations to training and husbandry practices

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The aim of the present study was to relate training and husbandry practices in Icelandic horses to horses' health and duration of competition career. Owners, riders, trainers and grooms (the person most familiar with the respective horse) of 9348 Icelandics with competition data available from the central registry of the Icelandic horse riders' and breeding association of Germany were contacted with an online survey to obtain information on horses' health as well as training and husbandry practices. Survey completion rate was 14% (n=1480). At the time of the study, 10% (n=148) of the horses were no longer ridden. Reasons included death (31%/n=47), retirement (7%/n=11) or health problems of the horse prohibiting riding (25%/n=37, of which 8 were now used for breeding), use for breeding (22%/n=32) and other reasons (12%/n=18). Average age of retired horses was 19.4 years, at death 17.6 years. A further 14 % (n=193) of the sample were no longer registered as a competition horse due to rider's lack of time (16%/n=31) or intentions to continue competing with that horse (15%/n=28), horse health problems (11%/n=21), horse deemed unsuitable for competition (3%/n=6), poor performance (2%/n=3), unspecified (24%/n=47) and other reasons (9%/n=18). The most frequent health problems (total of 67%/n=995 affected) related to the locomotor system (43%/n=619), followed by the respiratory system (19%/n=270), the digestive system (18%/n=264) and the sensory system/skin (17%/n=244). The vast majority of Icelandics was kept in group housing (94%/n=1396) and had pasture turnout (97%/n=1445), mostly 7 days per week (87%/n=1430). Survival analysis accounting for right-censored observations (i.e. correcting in horses still active for riskfactor specific probabilities to continue their career) revealed that husbandry and training practices such as husbandry system during rearing, age at training onset, duration of initial training, duration of training break after initial training, average duration of training sessions, warming up or of yearly training breaks did not significantly (all $P>0.05$) influence duration of competition careers. Surprisingly, reported health problems were associated with a lower ($P<0.05$; HR: 0.74, [95%CI: 0.63-0.88]) risk to terminate competition career. Notably, however, horses trained up to 4 times/week remained registered for longer as a competition horse (HR: 0.805 [95%CI: 0.67-0.97]) than those trained 5 or >5 times/week (both $P<0.05$). Furthermore, horses receiving longer (>5 hours/day) rather than shorter daily pasture turnout were at a lower risk to terminate their competition career. These results underline the importance of adequate training intensity and turnout to horse health and/or fitness.

Lay person message: The study showed that the vast majority of Icelandic sport horses in Germany are kept in groups and with pasture turnout and that they live on average up to a comparably old age, whereby the majority of competition careers are terminated based on owner-related reasons rather than horse health or death. Importantly, the study showed an advantage (longer competition careers) for horses with long (5 or more hours/day) rather than short daily pasture turnout and with moderate (≤4 times/week) rather than high (≥5 times/week) training frequencies, suggesting that such husbandry and training practices might be favourable for health and/or performance.

Keywords: Icelandics; housing; training; competition; longevity; health.

Behavioral observations and owner perceptions of working mules in three different countries

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Do mules have a place in the field of Equitation Science? We believe they do. Many of these equids work > 6 hr/d for their owners' well-being. Over the past 6 years, we have assessed physical and behavioural welfare measures in over 900 mules and surveyed owners/handlers from Egypt, Peru and Mexico. These mules have been involved in brick kiln work, pulling goods by cart, packing goods by saddle, providing tourist transportation and herding cattle. Physical measurements showed mules faring better than donkeys in comparable environments. In Egypt: 32.6% mules (n=410) versus 53.5% donkeys (n=750) scored BCS ≤ 2 (1-5 scale), while 26.8% mules showed initial signs of heat stress versus 48.3% donkeys, and fewer lesions (19.1%) than donkeys (32.9%; all P ≤ 0.05). Welfare assessments indicated a higher percentage of undesirable behaviour (e.g. aggression, avoidance) as compared to horses and donkeys in similar environments. In Peru (n=48): 38, 34 and 28 mules allowed forehead contact, neck approach and ear touch, respectively, by a familiar person (FP). The comparable numbers were 23, 0, 0 for an unfamiliar person (UP). In Egypt (n=374; separate study) approach tests indicated that 30% of mules exhibited signs of aggression (e.g. bite threat) when approached by an UP; 16% towards FPs. 46% of mules accepted chin contact by Ups, 66% by FPs. Overall 20% and 39% mules (n=410) showed aggressive and avoidance response to UP compared with 3% and 16% of donkeys (n=1140), and 6% and 20 % of horses (n=570). In Mexico (n=42) approach tests showed donkeys tended to be more tolerant of UP than mules or horses (P=0.08), with 100% donkeys, 29% mules, 17% horses allowing an ear test by UP. It is a causality dilemma that has us perplexed. Does the belief that mules are particularly difficult to handle cause handlers to treat them harshly, creating animals who display aggressive/avoidance behaviour as a defence? Our participatory interviews suggest that mules are easier to handle by FP versus UP. In Peru (n=14), owners agreed it was easier for them to work with their mule vs UPs. In Egypt (n=374), 58% participants believed that mules kick and bite often, but only 37% reported they kick, or bite only when being teased or beaten. More than 1/3 of the handlers confirmed that they were previously kicked or bitten by mules.

Lay person message: Mules serve an important role as working equids in many global communities. However, our data suggest that they require more knowledgeable handlers in order to reduce the adverse behaviour that is frequently observed. Though physically they are often faring better than horses and donkeys in comparable environments, more education and training is needed to address mule behaviour and training. Interviews suggested a need and desire for information on mule husbandry which could possibly improve overall mule welfare.

Keywords: mules; working equids; behavioural observations; welfare assessment.

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Effects of transportation on gastric ulceration and gastric pH

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The current study was conducted to determine the effect of 12 hours transportation on gastric ulcer scores and gastric fluid pH in horses. Twenty-six Standardbred, Thoroughbred and Warmblood mares were included in the current study. Twelve of these mares completed a preliminary study where they remained confined in reproductive crushes for 12 hours overnight to simulate the time subsequently spent in the transport phase of the study. To enable serial sampling of gastric fluid, indwelling nasogastric tubes were placed under endoscopic visualisation (T0). Horses were gastroscoped the following morning (T1) and again after 60 hours recovery (T3) to assess gastric ulceration. Gastric fluid was aspirated every two hours during overnight confinement. Twelve days after the preliminary study, all horses were transported for 12 hours in two consignments, each of thirteen horses, on consecutive nights. Nasogastric tubes were placed in the same twelve horses as during the preliminary study, with six of these horses included on each journey for collection of gastric fluid samples every 2 hours during travel. All horses (n=26) were gastroscoped prior to transportation (T0), immediately on return (T1) and after 60 hours recovery (T3) for scoring of gastric squamous and glandular lesions. Gastric fluid was collected endoscopically from all horses at T0 and T1. Only one horse demonstrated increased gastric ulcer score during confinement, and one additional mare had worsened (from grade 0 to grade 1 to grade 3 lesions of the lesser curvature) by T3. At T0 gastric pH ranged from 1.31 to 6.65 (median 2.43), with the majority of samples pH<4. Gastric fluid pH remained <4 overnight for the majority of horses. During transportation, pH ranged from 3.63 to 7.36 (median 7.13, n=12) and remained elevated in the majority of horses. Gastric ulcer scores were increased following transportation (T0 vs T1) for 17 of 26 horses. Twelve horses had improved spontaneously by T3, but a total of six horses exhibited increased ulcer scores compared to T1. At T1, lesions of the fundic squamous mucosa were observed in 12 (of 26 horses). These lesions improved without treatment following transportation, however lesions of the lesser curvature appeared less likely to resolve spontaneously. Based on endoscopic findings at T3, nine (of 26) horses were treated with omeprazole for gastric ulceration ≥ grade 3 severity. Transportation was associated with increased pH of gastric fluid suggesting mucosal damage was mediated by factors other than gastric acid secretion.

Lay person message: The preliminary findings of this study suggest that transporting horses over long distance in fasting conditions affects gastric pH and causes the development of gastric ulcers. During transportation the stomach pH was higher than 4 in the majority of the horses probably due to bile reflux caused by decreased gastrointestinal motility. To prevent possible transport related gastric ulcers situations to that tested (i.e. travelling for 12 hours without feedings and watering) should be avoided.

Keywords: transportation; fasting; stress; pH; ulcer.

Locus of control and human behaviour as a preemptive predictor for good welfare in working horses

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In Haiti and Honduras, the leading role of a working equine is to provide transportation for families and transport products to and from marketplaces. While there is agreement that good welfare is key for overall health, it is not uncommon for behavioural welfare to be overlooked as an important aspect of welfare. Human behaviour is a common root cause of equine behaviour issues. While traditional approaches aim to improve equine welfare on a physical level through in-country service, accessibility to medical treatment, or campaigning to change current habits, there is a paucity of research dedicated to the understanding of human behaviour directed toward their equine partner. The purpose of this study was to gain insight into human behaviour through the psychological lens of Locus of Control (LOC) to potentially identify an additional factor contributing to the overall welfare of the equine species. LOC theory describes individuals as having either an internal or external LOC. Those who believe that personal abilities, efforts, and or actions principally determine the outcome of their life are classified as internal. Those who believe that fate, luck, chance, or other outside forces dictate the outcomes of their life are classified as external. Over a period of four days, each of 65 Honduran equid owners were administered a LOC survey during a face-toface interview. LOC scores of < 11 (out of 23) were classified as internal and >12 as external. In addition, a 32-item survey focused on better understanding owner knowledge for the working equine was administered and an equine welfare assessment, comprised of 6 key attributes commonly associated with welfare and further broken into 18 subcategories of welfare, was conducted on each owner's equine for comparison. Owner LOC was negatively correlated with behaviour welfare score (Pearson r =-0.247, P=0.047, n=65) with 95% confidence. Equines whose owners scored higher on LOC (more external) tended to score lower on the behaviour category of the welfare assessment (e.g. equines with a lower behaviour score were more likely to avoid contact with or showed physical signs of aggression toward unfamiliar observer approach). Additional data indicated 47.6% of the sample had a BCS range of 1-2 (on the adapted 1-5 BCS scale). With this information, proactive welfare improvement can be approached by tailoring to those displaying external LOC's. Creating personal relevant education to future populations may provide owners with a stronger drive to change current habits for better equine welfare.

Lay person message: Understanding and identifying human behavioural traits is pertinent in understanding underlying causes of poor behavioural welfare. Owners of 65 Honduran horses participated in a psychological survey to identify their perceptions on the amount of control they felt they had in life; the results were compared to a welfare assessment conducted on their horse. It was found that owners who scored higher on the survey (indicating they felt out of control in the occurrences in their lives) had horses who scored lower on the behavioural category on the welfare assessment; indicating owners' psychological outlook was associated with overall behavioural welfare of the equine.

Keywords: human behaviour; behavioural welfare; Locus of Control; attitude; perception; working equines.

Does on-farm management affect donkeys' welfare?

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Donkeys in Europe are kept as pets, used for leisure activities, therapy programs, or milk and meat production. Donkeys' management, and thus their welfare, differs significantly among farms. The aim of this study was to evaluate differences in donkey welfare related to different on-farm management. To do so, data related to the welfare of donkeys (Dai et al, 2016; 2017) have been analysed in collaboration with the MOXstat group of the Department of Mathematics of Politecnico di Milano. The AWIN welfare assessment protocol for donkeys, including 22 animal-based indicators, was applied in both cited studies. Furthermore, information regarding farm management was collected. A total of 524 donkeys housed in 28 stables were assessed; animals were used for different purposes: milk production (N = 16; donkeys = 323), sanctuaries (N = 6; donkeys = 160), leisure or animal assisted therapy (N = 6; donkeys = 41). A comparison between milk, sanctuary and riding-therapy stables was made using Multiple Correspondence Analysis (MCA). MCA is an extension of Correspondence Analysis (CA), which allows to analyse the pattern of relationships of several categorical variables. Behavioural data was analysed using Principal Component Analysis (PCA) and One-Way Manova to find differences between farms with diverse attitude. Finally, a cluster analysis was performed in order to find relationships among behavioural indicators. MCA found significant differences between donkeys kept in milk farms and sanctuaries: bad hoof condition and presence of alopecia and skin lesions were more likely to be found in milk farms ($P<0.01$); vice versa, discharges affected more frequently donkeys kept in sanctuaries ($P<0.01$). These differences seem to be related to age and not animal management (logistic regression, $P<0.01$). No significant differences were found between leisure-therapy farms and the others. The PCA found three principal components (explaining together the 79.3% of the total variance); significant differences (Manova, $p<0.01$) were found on the second principal component (PC2) only between milk farms and sanctuaries: donkeys in sanctuaries were described as more at ease, happy, playful and relaxed, while animals in milk farms were described more frequently as apathetic and withdrawn. As for the relation between Human-Animal relationship variables and Qualitative Behaviour Assessment (QBA) variables, cluster analysis revealed that donkeys described as less happy and relaxed had higher avoidance distance towards an approaching human. These results confirm the hypothesis that management differences related to diverse use of animals have an important effect on donkeys' welfare.

Lay person message: Management procedures can have an important effect on donkeys' welfare. In this study, data related to welfare of donkeys was analysed in relation to different on-farm management. Differences were found between donkeys kept for different purposes (milk production, sanctuaries, leisure or animal assisted therapy), both with respect to clinical (poor hoof condition and presence of alopecia and skin lesions were more likely to be found in milk farms) and behavioural indicators (donkeys in sanctuaries were described as more at ease, happy, playful and relaxed). A targeted dissemination of information on the best management practices among farmers could improve welfare of donkeys kept for different purposes.

Keywords: donkey; welfare; management.

A pilot study investigating the effects of saddling and bridling on stress levels in college horses using heart rate and behaviour as measures

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Throughout the domestication of the horse, humankind has discovered ways to facilitate this process to produce a capable and trainable companion. However, some of these techniques cause controversy, as various aspects of both saddles (S) and bridles (B) may have an adverse effect on welfare. Studies on B in particular report concerns perhaps due to modern designs becoming more complex. Correct fit for both S and B is paramount to most owners and handlers, however there exist horses who react aversively to the tacking up (TU - saddling and bridling) process. The study aimed to determine whether horses found the process of TU to be stressful. The test group consisted of college horses (n=5) varying in age and breed. Using a heart rate (HR) Polar V800 monitor mounted on a roller, resting HR and peak HR were measured while in the process of TU. Behavioural observations and HR recording began ten minutes before TU and continued for ten minutes after TU completion. Each horse was habituated to wearing the roller in previous experiments. During the experiment subjects' behaviour, frequency (as tallied) was monitored using an ethogram with two observers. Behaviours monitored were head movement, steps taken, vocalisation and ear movement. Each horse was monitored with B TU and then separately with S TU in one session with no repeats. One-way ANOVAs were performed with resting and peak HR on both measures of TU. There was no significant difference in increase in peak HR compared with resting HR when TU with B ($F=0.16$, $df=1$, $P=0.696$), or S ($F=0.17$, $df=1$, $P=0.689$). A Wilcoxon Signed Rank Test reported comparison of resting HR with both B and S was non-significant across all subjects ($W=15$, $P=0.059$, range 33.5-37 beats per minute). A one-way ANOVA indicated that no behaviour occurred significantly more than another ($F=0.912$, $df=3$, $P=0.451$), and a Wilcoxon indicated median frequency of behaviours observed as 1 behaviour ($W=78.0$, range 0.5-1). Results possibly indicate college horses used in this cohort do not associate TU with a stressful process explaining the lack of significant change in HR and low rates of behaviour frequency seen. Lack of a rise in HR amongst this cohort is noteworthy, potentially indicating the horses are safer for less experienced riders to handle. A proposed reason for the lower signs of stress could be complementary management techniques at the college in question and therefore contrasting results might be obtained at other premises.

Lay person message: Horses are a prey species, easily stressed by environmental events. The relevant behaviour in response to these can affect both physical and mental welfare as well as create a dangerous situation for the rider and handler. In this study, college horses were monitored for heart rate changes and frequency of behaviour. There was no significant reaction by the horses to being tacked up, so possibly indicating these methods might be useful for testing stress amongst horses at other colleges with different methods of husbandry.

Keywords: Stress; saddling; bridling; welfare; heart rate; behaviour.

Evaluating muscle tension as an indicator of stress in riding horses

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Muscle tension (MT) and pain have been linked to stress in humans, and pain has been linked to decreased performance in horses. Acute stress has been associated with increases in serum cortisol concentration (SCC) in equines, while chronic stress under challenging conditions has been shown to reduce SCC. The purpose of this study was to evaluate changes in SCC and MT in horses to determine if MT evaluation can be used to assess equine stress. It was hypothesised that changes in SCC and MT would be correlated. Experiment 1 assessed therapeutic riding (TR) horses (n=17) during 2 consecutive 8-week sessions. Experiment 2 assessed university (UNI) riding horses (n=25) during a 16-week semester. All horses were under light work. Jugular blood samples were collected for SCC during weeks 1, 5, and 8 for TR horses, and during weeks 1, 9, and 15 for UNI horses. Samples were collected before (PRE), immediately after (POST), and 30 minutes (30M) after the ride. Muscle tension (MT) was evaluated by an experienced equine massage therapist during weeks 1 and 8 of each riding session for TR horses, and during weeks 1, 9, and 15 of the semester for UNI horses. Muscle tension was scored on a scale of 1.5 to 2.5 points at 10 locations on each side of the horse. A 1.5 indicated healthy muscle with even tension, while a 2.5 indicated muscle with uneven tension. Statistical analysis was performed using PROC MIXED of SAS to determine changes in SCC and MT. Significance was declared at $P \leq 0.05$. Values for SCC were within or slightly below normal reference ranges. Group mean SCC in both experiments decreased from PRE to POST to 30M ($P \leq 0.0001$). This suggests that horses were more stressed before the ride. Over time, mean SCC increased from weeks 1 to 8 ($P \leq 0.0002$) in TR horses and weeks 1 to 15 ($P \leq 0.0001$) in UNI horses. Work demands increased during riding sessions, and SCC changes may have been related to changes in exercise. Increases in MT over time were observed for facial muscles in both experiments ($P \leq 0.026$). Facial muscles could have been impacted by riders, resulting in increased tension in this area as riding sessions progressed. No correlation between SCC and MT suggest neither TR nor UNI horses were experiencing increased stress during riding sessions. Future research should include more horses experiencing increased exercise challenges to see if correlations between SCC and MT exist.

Lay person message: Abnormal muscle tension can lead to headaches and skeletal muscle soreness in humans. It is possible equids experience similar stressors. Stress can be measured with the hormone, cortisol; acute stress is associated with increased cortisol concentrations. This study evaluated whether a link exists between muscle tension and elevated cortisol concentrations in horses. Horses are unable to verbalize muscle pain; this study hopes to improve equine welfare by identifying whether or not abnormal muscle tension can indicate stress in horses. No connection was confirmed between muscle tension and cortisol, but facial muscle tension rose suggesting an impact by riders.

Keywords: muscle tension; stress; serum cortisol; riding horses.

Canadian equine industry views on affective states in horses

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People often ascribe human emotions to how they think their horse is feeling. In an effort to better understand the breadth of viewpoints held by Canadian equine industry participants, multiple topics were covered throughout an online survey with Likert scale questions inquiring about the participants' views on what horses feel (i.e. what affective states horses were capable of experiencing) as well as their opinions on horse-human shared activities such as riding and training. Descriptive statistics showed that participants (n=901; 649 female, 54 male, 198 unstated) strongly agreed that horses were capable of experiencing affective states, including fear (95%), pain (94%), boredom (89%), frustration (85%), depression (73%), sadness (63%), jealousy (57%), anger (65%), happiness (67%), and love (50%). A Pearson chi-squared tested the strength of these opinions in relation to management and training practices. Despite strongly believing that horses could feel pain, this was not considered a reason why a horse might perform conflict behaviours while being ridden (x^2 (1, N=719)=1.93, P>0.16) or trained (x^2 (1, N=719) = 0.723, P>0.39). Participants most commonly (67%) attributed conflict behaviour to poor cueing from riders and trainers. Similarly, participants did not object to hot branding either with (x^2 (3, N=140) = 4.98, P > 0.17) or without (x^2 (3, N=140) = 0.725, P=0.86) pain control. With respect to stereotypic behaviour, participants believed weaving (x^2 (15, N=679) = 26.63, P=0.032) and cribbing (x^2 (27, N=679) = 50.54, P=0.004) were predominantly caused by boredom. Participants related lack of turnout to horses experiencing frustration (x^2 (3, N=648) = 13.34, P=0.004), fear (x^2 (2, N=721) = 6.80, P=0.033), and pain (x^2 (1, N=719) = 4.80, P = 0.028). Although 79% of participants were familiar with natural horsemanship, only 46% regarded it as the most humane training method. Those who agreed with natural horsemanship training methods felt that horses did not ever feel fear (x^2 (6, N=563) = 7.33, P>0.29). While industry participants may believe that horses have the capacity to experience a wide variety of affective states, a better understanding of what horse enthusiasts believe causes horses to experience these states is needed. By determining these gaps in knowledge, an effort can be made to improve education in these areas with the intention of bettering the horse-human bond.

Lay person message: A nation-wide survey distributed to Canadian horse enthusiasts indicated that they strongly believe that horses can feel a wide variety of emotions including fear, pain, boredom, frustration, depression, sadness, jealousy, anger, happiness and love. Anthropomorphic interpretation of affective states may influence training and management practices. For example, even though most survey participants believed that horses could feel pain, they did not believe that pain was a reason for conflict behaviours demonstrated under tack. Understanding beliefs regarding affective states of horses can aid in tailoring education programs targeted to improve horse welfare.

Keywords: horse; affective states; emotions; pain; survey.

Impact of educational campaign on owner knowledge and approach to equine colic

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The role of the owner is pivotal in the early recognition of horses with colic. Previous research by the University of Nottingham identified gaps in horse owner knowledge. This led to the development of an educational campaign 'REACT Now to Beat Colic' based on evidence reviews, surveys and multi-stakeholder workshops. The aim of this study was to assess the impact of educational resources for horse owners. Free campaign resources were distributed by The British Horse Society from September 2016 through various media. Campaign materials were emailed to 93,000 BHS members and posted to all equine veterinary practices. Over 20,000 hard copy resources were distributed at equine events, information evenings, scientific meetings or direct requests. There were over 100,000 'hits' on educational videos and 400,000 social media reaches over 12 months. One year post campaign release, an online survey evaluated horse owners' awareness of the campaign and its potential impact upon behaviour. Survey participants were recruited using a snowball sampling strategy; descriptive analysis of the data was performed. A total of 1286 horse owners participated in the survey; 37% (450/1205) were aware of the 'REACT' campaign, mainly through social media (21%). The most recognised resource was the 'REACT' quick reference guide (334/426) which was launched two months prior to the survey. Despite high levels of recognition, 30.8% of owners who were aware of this resource had not read its content in comparison to 12.9% who had actively read and used the information to plan emergency decisions. The majority of owners who were aware of the campaign resources felt all topics covered were useful, but have not yet implemented the information or feel it has changed their approach. The survey may be subject to response bias as sample size was small. As colic is usually a short-lived sporadic episode, use of resources may depend on whether owners had experiences of colic after the campaign launch. This is the first study to evaluate the effectiveness of an equine health campaign. This study shows that educational campaigns require a regular reflection and provision of stakeholder support. Campaign awareness does not always result in behaviour change in the target population and further research on influencing behaviour change to benefit the health and welfare of the horse is required.

Lay person message: Recognising colic early and acting quickly gives horses the best chance of recovery. An evidence-based education campaign 'REACT Now to Beat Colic' was developed, and a wide range of methods used to promote and disseminate free campaign resources. An online survey, of 1286 horse owners found that 37% were aware of the campaign, and an effect on owner behaviour was noted in several areas. This was the first study to investigate the effectiveness of an equine health campaign.

Keywords: colic; owner awareness; welfare; health; campaign; education.

Horses prefer food over human contact for task reward: considerations for human–horse bonding

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Humans use food rewards as positive reinforcement for training horses, but there is little evidence to show that human contact (scratching or patting) has reward value or if domestic horses perceive human touch as social bonding. This study looked at whether horses view human interaction as a form of positive reward by examining the reward value of scratching and patting compared to known rewards (treats), based on horses' ability to use symbols to show preferences. It also explores horse-human social bonding opportunities based on the unique backgrounds of each equine subject and variations in behaviours towards known and unknown humans. Eleven (N=11) horses (6 geldings, 5 mares with age range 4 -20) with known histories were tested on six different days with two different researchers (one familiar and one unfamiliar) and two symbol sequences to account for testing variables. Each horse was trained to touch a target (X) for a treat reward (given in a bucket). The symbols were then changed to reflect either scratching (O) or patting (square) and presented in rotating pairs to ensure symbol distinction as well as to test preference. Each horse was then subjected to a varied sequence of single targets. Number of times the target was touched (maximum of ten touches), behaviours, and inter-trial intervals were recorded as well as individual backgrounds on each horse regarding previous behaviours towards humans. In a paired t-test for the last trial, all horses (N=11) showed significant difference between target touch counts for treats versus scratches during the last trial ($t(10) = 61.55$, $P<.001$), significant difference between target touch counts for treats versus pats ($t(10) = 21.47$, $P<.001$), and no significant difference between target touch counts between treats versus pats ($t(10) = -1.35$, $P= .208$). All equine showed preference for treats over human contact with no variation between those who typically voluntarily seek out human interaction versus those who typically avoid human contact. This study suggests that, for performance-driven behaviour, horses prefer food rewards over human interaction. Considering the variations in backgrounds of individual horses, the potential role of dopamine and cortisol as excitatory variables, and the potential impact these might have in equine social contexts, this brings up further opportunities to explore how horses view humans in a companionship role and if or when human interaction is appropriate for a desired result.

Lay person message: Equine welfare can, in part, be determined based on the equine perspective of human contact. This experiment compared horses' preference for treats versus pats or scratches as a reward when touching a target. The horses varied in their training and handling backgrounds and the experiment was conducted with varied series of targets by two different researchers over six days. The results indicate that horses preferred treats over human contact for rewards for performance.

Keywords: reward; preference; positive reinforcement; human-animal interactions.

Impact force distribution between horse and rider al walk, trot and canter

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Equestrian sports entail two moving bodies generally of >500 kg of mass that are being impacted in strenuous and repetitive ways against the ground with no more than the horse's and rider's bodies being used to absorb these impacts. However, little is known on how the impact is distributed through the horserider dyad and which are the potential threats of this distribution. The aim of this study was to investigate the impact transmission from (i) the horse's hoof through (ii) the saddle to (iii) the rider's sacrum, (iv) multifidus muscles (MF), (v) erector spinae muscles (ES) and (vi) occipital area of the cranium (OCC). Six showjumpers (regional level >1m) aged 24 ± 7 years volunteered to take part in this study. Standardized instrumentation and horse warm-up were performed before each session. Acceleration was recorded with inertial measuring units (IMUs) (EMGworks, Delsys, USA) at the horse's left hoof, saddle cantle, rider's sacrum, MF at the level of L5, ES at the level of L1 and OCC. Mean and peak accelerations were mathematically transformed to impact forces and normalized to the impacts recorded at the horse's hoof. Seventy strides were analyzed during each gait for each rider, using the same horse and instrumentation set-up. A 2-way RM ANOVA (site*gait, Tukey HSD post hoc) was conducted for both mean and peak impact forces. Impact forces differed significantly across sites and locations ($P<0.001$). In addition a Kurskal-Wallis test for non-normal data, showed significant differences across sites ($P<0.001$) and gaits ($P<0.02$). Post hoc analysis revealed lower forces at all sites compared to the horse's hoof ($P<0.001$) at all gaits. On the riders' spine, significantly higher impacts were recorded at the MF (mean±SD at walk = 6±4%, trot = 9±7% and canter = 12±6%; peak±SD at walk = 3±2%, trot = 10±15% and canter = 11±6%) followed by the saddle, sacrum, ES and OCC ($P<0.05$). This study shows that 10 to 25% of the forces from the impact generated by the horse's locomotion are being directly transmitted to the rider at the level of L1 during horse riding walk and trot, supposing a potential threat to the lumbar spine. At the same time, the saddle is under similar impact forces which act perpendicular to the horse's back. These findings are key to designing effective rehabilitation, prevention and strength & conditioning plans for both horse and riders alike, pointing towards the necessity of lower back reinforcement-focused programs.

Lay person message: This study demonstrates that the greatest physical strain during equestrian sports is set on the lumbar spine. Hence, conditioning and strengthening of the lower back is essential for preventing injuries when practicing these sports.

Keywords: back pain; injury prevention; rehabilitation; welfare.

Look where you are going! Monitoring the relationship between where you look and jump clearance in show jumping

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Visual judgement is key to successful performance in equestrian sports. In particular, the ability to guide the approach and take off point for successful clearance of obstacles will determine success in show jumping and eventing. The association between looking at the bottom of a jump and ending up there has long been noted by coaches. With the use of mobile eye tracking technology it is now possible to monitor where riders are looking (their point of gaze: POG) and how this affects performance. Eye tracking data was collected from riders (n=6) currently competing in either show jumping (at British Show Jumping Newcomers level or above) or eventing (at British Eventing Intermediate level or above). Following a warmup session the rider was fitted with a mobile eye tracker, calibrated for each individual. The rider walked the course and then mounted the horse and completed two practise fences. The test trials consisted of a course of four show jumps (height 115-120 cm) which was jumped three times. The data from the recording unit of the eye tracker was downloaded using visual analysis software. Reference pictures of each of the four show jumps were taken and areas of interest (AoIs) identified to enable the mapping of the riders' POG (top rail (T), middle rail (M), bottom (B)). Fixations (POG ≥ 100ms) were mapped to each AoI for each jump during the approach. The percentage of the approach time that each rider fixated on each AoI for each jump/round combination was calculated. Jump errors (knock-downs and refusals) were recorded. The effect of the independent variables: rider, jump number and round number, on the percentage of time fixations were recorded on each AoI was assessed (Kruskal-Wallis test). There was a significant difference between individual riders in how long their POG was located on each of the AoIs (T: $X2=46.61$, $df=5$, $P<0.001$; M: $X2=30.95$, $df=5$, $P<0.001$; B: $X2=37.46$, $df=5$, $P<0.001$). There was no significant effect of round number but the amount of time spent looking at M varied with the different jumps ($X2=8.02$, $df=3$, $P<0.05$). Too few errors were made to allow statistical analyses but the rider who looked predominantly at the bottom of the jump also made the most errors (n=3). Appropriate location of POG is an important factor in jump clearance. Further identification of the visual skills associated with equestrian sport will enhance training, safety and performance.

Lay person message: Where you look is important when approaching a jump and this can now be monitored using eye tracking technology. We used a mobile eye tracker to record the visual behaviour of riders when jumping a course of four jumps. We found individual differences between riders and also some proof that the more you look at the bottom of the jump, the more likely you are to end up there! This technology will help to identify visual skills that can be included in training to improve safety and performance in equestrian sport.

Keywords: Vision; jumping; training; safety; eye tracking.

Physical fitness profile in female horseback riders

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An experienced rider can follow the motions of the horse and influence the speed, direction, and activity of the horse with her/his stabilized and coordinated body. The systematic training of riding requires versatile information on physical performance capabilities, and the type and level of riding specify the needs and content of the physical fitness profile of a rider. The purpose of the present study was to examine the levels of endurance and neuromuscular performance by recording maximal oxygen uptake, maximal and explosive force production of the lower and upper extremities and trunk muscles as well as balance performance variables in female riders. 52 female Finnish riders volunteered to participate in the study, 19 show-jumping riders (SJ) and 33 eventing riders(E). Mean age was 29.4±8.9yrs, height 168.0±6.1cm, body mass 67.5±10.0kg and BMI 23.9±3.5. They rode a minimum of 4 times/week with the jumping level of minimum 1.06±0.11m. The riding skills of the participants were from the national to international level. Ethical approval for the study was granted by the University of Jyväskylä Ethical Committee. The measurements of bilateral isometric leg press force(MVCLP), unilateral isometric knee extension(MVCKE) and flexion forces(MVCKF), countermovement jump(CMJ), maximal isometric force of the trunk extensor and flexor muscles (MVCE, MVCF), weight distribution of the body (WD), handgrip strength (HGS), maximal oxygen uptake (VO2max), lactate threshold (L) and heart rate (HR) were performed in the laboratory of the Neuromuscular Research Center, University of Jyväskylä. Standard statistical methods were used for calculation of means and standard deviations (SD). Differences between two groups were tested for significance by Student`s t-test. Mean force in MVCLP was 1887(±455)N, MVCKE right/left 633(±134)N/628(±138)N and MVCKF right/left 420(±79)N/411(±74)N, respectively. CMJ height was 19.8(±3.9)cm and trunk forces in MVCE 51.2(±13.7)kg and MVCF 61.3(±11.4)kg. Mean WD in the right/left was 50.5(±2.2)%/49.5(±2.2)% and mean HGS right/left 39.9(±5.1)kg/9.2(±4.9)kg, respectively. Mean VO2max in the cycle ergometer test was 32.1(±4.5)ml/kg^{-1}/min^{-1}, HRmax 184.5(±9.6)beat/min, timemax to exhaustion 18.50(±2.50)min and Lmax 10.2(±2.1)mmol/l. The present SJ and E groups did not differ significantly from each other in any of the variables. The present results showed that MVCLP, MVCE and MVCF were at about the same level but VO2max somewhat below compared to non-athletic Finnish women of the same age. It would seem that the present female riders would obtain benefits from additional strength training and, on the other hand, by reducing body weight they would reach a better physical fitness profile in relation to their body weight.

Lay person message: This study showed that the muscle-strength levels of the lower and upper body including trunk muscles in the present female riders were at about the same level, but the endurance performance was somewhat lower compared to non-athletic Finnish women of the same age. It would seem that the present female riders would benefit of additional strength training and, on the other hand, of reduced body weight to reach a better overall physical fitness profile in relation to their body weight. The good physical performance level can contribute also to the success of the riding performance and wellbeing of the horse.

Keywords: Fitness profile; endurance and neuromuscular performances; balance; female riders.

Identifying information that can be trusted in the internet age: the challenge for horse owners

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We live in an age where information is more accessible than ever before. The availability of information online regarding a diverse range of subjects from multiple sources can be highly beneficial. But when there are no controls over what is published online it can be challenging to identify information that can be trusted. Consequently, despite search engines typically returning numerous results on many topics, owners still report difficulties in finding certain information. As part of a small project investigating optimal methods to communicate with leisure horse owners, an online survey was administered to a convenience sample of UK horse owners (N=310). The survey was online for one month in 2017 and participants were recruited via social media and relevant email lists. Only 33% of participants reported that they had access to all of the information they needed to look after their horse effectively. Limited access to scientific studies, including the latest research findings, and to information in an accessible format but with a strong scientific evidence base were reported as challenges by 36% of our sample. Subjects that owners had difficulties accessing trustworthy information on were: nutrition (14%), illness and injuries (7%), behaviour (6%), training and riding (4%) and fitting equipment (3%). It is important to note that the owners stated that while they had found information on these subjects, the information was either from potentially biased sources e.g. commercial companies, potentially unreliable sources or the sources themselves were relatively inaccessible due to the language used. The level of trust in the organisation responsible for publishing the information was also raised as an issue. For example the UK government Department for Environment, Food and Rural Affairs (Defra) were not seen as a trustworthy source of equine information by 11% of survey participants. It is a really encouraging to find that owners are striving to gain access to evidence based advice and scientific studies. ISES and other equine science associations are in a strong position to address this identified need, acting as portals for accessing reliable, unbiased, contemporary, evidence based information. The challenge faced now is how to raise owner awareness of appropriate websites and resources - simply relying on owners finding them while searching online may not be enough. Equitation scientists need to be proactive in raising their profile in all sectors of the equestrian community as trusted information sources.

Lay person message: Although it is getting increasingly easy to find information, especially online, it is often difficult to access and to know if the information from a particular source is trustworthy. A survey of UK horse owners found that only a third of participants were able to access all of the information they needed. Many participants were actively seeking evidence based information and scientific research but had difficulties accessing it. We all have a role to play in raising owner awareness of trusted information sources and improving accessibility of research findings.

Keywords: advice; dissemination; equine; information; survey; trust.

Lack of knowledge is not a constraint on optimal equine management

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Research into equine welfare has generated scientific evidence on how domestic equines should ideally be managed. Many of the recommendations for best practice have filtered out to the equine owning population, yet often these have not been implemented. Lack of owner education is a commonly cited explanation for a lack of uptake, but how true is this? Qualitative data were collected via an online survey of UK horse owners (N=391) to identify what they perceived as constraints on the implementation of optimal management practices for their horse. The participants were recruited online via social media and relevant group email lists. While 23% of participants reported that they currently managed their horse(s) as they would like to, more than three quarters (77%) of the owners sampled discussed barriers that were preventing them from managing their horse(s) in the way that they would ideally like to. The most common reasons cited were financial constraints (27%), followed by rules imposed by livery yards (22%) and a lack of space and/or facilities (17%). Other barriers included the weather as it relates to ground conditions (5%), illness or injury of the horse (3%), other horse owners (2%), convenience (1%) and fear (1%). Lack of knowledge was only reported as a barrier by 1% of survey participants. The findings suggest that a lack of owner education is not the primary explanation for poor uptake of optimal management practices. Many owners are aware of recommendations but their uptake is influenced by other constraints. It is these barriers that we need to address in our ongoing research and dissemination activities. Owner education is of limited value if they cannot see how to overcome the barriers to implementing it in practice, be these perceived or otherwise. Providing information on how these obstacles can be overcome and how research findings can be implemented in a 'real world' set up by adapting existing facilities and practices would be highly beneficial for owners and ultimately the welfare of their horses.

Lay person message: A lack of owner education is often held responsible for the failure to adopt recommended management practices that promote horse welfare. An online survey of UK horses found that only 1% of owners sampled reported that a lack of knowledge prevented them from keeping their horse(s) in the way that they would like. More common reasons included money, livery yard rules and lack of space or facilities. It is these constraints on implementing optimal welfare that we need to address in our research to help promote best practice and horse welfare.

Keywords: equine; management practices; owner perceptions; welfare.

Preliminary study investigating trunk muscle fatigue and cognitive function in event riders during a simulated jumping test

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The Olympic discipline of eventing is the triathlon of equestrian sport, consisting of dressage, cross-country and show jumping. Falls on the cross-country are common and can be serious even causing death to rider. Research identifies an increased risk of a fall with an increasing number of obstacles and for jumping efforts later in the course suggesting fatigue may be a contributing factor. Advice based on anecdotal evidence suggests riders undertake strength and conditioning programs to improve their 'core', thus improving their ability to maintain and control their riding position. There is little empirical evidence to support this advice. Therefore, the aim of this study was to investigate trunk muscle fatigue and cognitive function during a simulated jumping test. Eight adult riders participated in a riding test on a Racewood Event simulator for 10 minutes, over a continuous jumping programme. The Surface electromyography (SEMG) activity of six trunk muscles were bilaterally measured at every minute, and normalised root mean squares (RMS) and median frequencies (MDF) were computed from the EMG power spectra. Visual analogue scales (VAS) measuring Fatigue and Pain levels and Cognitive Function 'tapping' tests were performed before and after the riding test. Average MDF values for all muscles differed significantly between each sampled minute ($p = 0.017$), however a consistent decrease from Minute 1 and Minute 9 was not found, suggesting the trunk muscles fatigued and then recovered as other muscle groups important in maintaining the riding position during dynamic movement compensated. Differences between the MDF and RMS of different muscles were highly significant ($H=213.01$, $DF=5$, $P<0.001$), supporting previous anecdotal evidence that different trunk muscles carry out different roles of posture maintenance during riding. RMS values were not significantly different between the sampled minutes or between riders, suggesting the riding test produced a consistent and repeatable effect on the trunk muscles. MDF values differed significantly between riders ($H=50.8$, $DF = 5$, $P<0.001$), suggesting individuals may experience localised muscular fatigue of the same test differently, and that other parameters of physical fitness should be investigated to provide conclusions. Lumbar muscles were shown to be important in maintaining the position, therefore physical training programs should focus on these areas. No significant differences were found between pre- and post-riding test VAS Pain and Fatigue scores or cognitive function test scores, suggesting the riding test was not significantly fatiguing for participants. However, a near significant correlation was found between time of riding test and VAS Pain score ($P=0.06$), suggesting somatic pain may be a limiting factor to performance. No other correlations were found between the factors of participant riding test time, VAS Pain and Fatigue, however a larger sample needs to be tested to improve statistical analysis. The findings suggest the simulator riding test was not sufficient to provoke fatigue in the riders, however foundations for future studies have been laid to enable methodologies in realistic eventing settings.

Lay person message: Muscle activity of six trunk muscles were measured during a 10 minute jumping test on an equine simulator. Fatigue and Pain levels of riders was recorded and Cognitive Function 'tapping' tests were performed before and after the riding test. Muscle activity differed between muscle groups during the test but a consistent decrease in muscle function was not seen, suggesting the trunk muscles fatigued and then recovered as other muscle groups important in maintaining the riding position during dynamic movement compensated. Riders did not report significant levels of fatigue during the test but did report an increase in pain levels the longer they rode the test.

Keywords: Eventing; fatigue; horse-rider; trunk muscles; Surface EMG.

The effect of rider handedness on rein tension in walk, trot and canter on a mechanical horse

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Rein tension applies force through the bit to control the horse. Welfare concerns arise from the use of rein tension, including mouth ulceration and conflict behaviours that occur when the horse attempts to relieve the pressure applied. A symmetrical contact is advantageous during training to promote straightness and prevent asymmetrical training and development. Rider handedness has a profound effect on the motor control of the dominant and non-dominant hand which requires more research in riders. The aim of this study was to investigate whether rider laterality has an impact on the symmetry of rein tension. Further aims included evaluating if there was a difference between left and right-handed riders and whether experience level had any significant effect. Data was collected using a device that measures rein tension in grams. The sample consisted of 20 riders, 10 of each handedness. Maximum and average rein tension was calculated for each rider in three thirty second intervals at each gait. A paired T-Test or a Wilcoxon's Signed Rank test was conducted on the rider's data at each gait in accordance with the normality of the data set. There was no significant difference found in the rein tension between the dominant and non-dominant hand for the maximum values at walk and trot, or for the average rein tension at walk ($P>0.05$). Significant differences were found for the average rein tension at trot and canter, and for the peak values at canter where the maximum rein tension was applied by the non-dominant hand ($P<0.05$). In all gaits for the maximum and average values the mean rein tension supplied by the non-dominant hand was greater than the corresponding value for the dominant hand. The results suggest that the degree of asymmetry in the rein tension becomes more significant as you transition up through the gaits. It may suggest that rider laterality causes increased rein tension from the non-dominant hand. This could be due to a variety of reasons including the differences in motor control of the dominant and non-dominant hand. This affect was most significant in left-handed riders at all gaits ($P<0.05$). These findings suggest that both riders and trainers should be aware of the effect of rider laterality to promote balanced and symmetrical riding and training. Further education is needed for both riders and trainers to improve training techniques and performance, which would decrease the risk of injury to the horse and increase equine welfare.

Lay message: Riders should consider that their own handedness might have an effect on the pressure that they apply to the horse's head and mouth via the reins. The degree of asymmetry shown between the rider's dominant and non-dominant hand may increase as you transition up through the gaits, especially in left handed riders. This study is of use to both riders and trainers and will help promote symmetry which will lead to increased clarity of the aids which is beneficial for both horse welfare and rider safety.

Keywords: equine or horse; rider; laterality; rein tension, training, welfare.

Do horse owners know how to care for their horses?

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Horse owners have a duty of care to safeguard the wellbeing of horses in their care. However, within recreational equine populations, a substantial proportion of welfare problems reported are linked to unintentional neglect due to owner ignorance. This study assessed the equine knowledge base in a preliminary sample of UK horse-owners (n=128) with variable educational achievements (low, no degree: n=74, medium: undergraduate degree, n=27, high: postgraduate qualification, n=27). Respondents (horse owners/riders, >18 years) completed 40 voluntary equine-related questions in an online multiple-choice survey, distributed via equine-related FacebookTM sites, covering topics related to equine management, health, behaviour and welfare, categorised as easy (n=14), medium (n=14) and hard (n=12). The majority of respondents answered 'easy' questions correctly (78.71%), with 18.36% selecting incorrect answers and 2.93% stating they didn't know the correct answer. Less than half of the participants answered 'medium' questions correctly (47.29%), with 31.51% selecting the incorrect answer and 21.21% not knowing the correct answer. Even fewer respondents attained the correct answer for the 'hard' questions (21.51%), with the majority either selecting the incorrect response (46.17%) or not knowing the correct answer (32.32%). Differences in correct responses between the question categories were significant (ANOVA: P=0.0001, f=25.18, df=2), with post-hoc analyses revealing participants selected more correct 'easy' answers compared to 'medium' (LSD: p=0.001; means: 78.71% vs 47.29%), and 'hard' answers (LSD: p=0.001; means: 78.71% vs. 21.51%), and more 'medium' than 'hard' (LSD: p=0.003; means: 47.29% vs 21.51%) answers. Interestingly, it appears participants increased their selection of 'don't know' as their preferred response as question difficulty increased; 'don't know' responses increased between the 'easy' and 'medium' questions (LSD: p=0.004; means: 2.91% vs 21.21%) and 'easy' to 'hard' questions (LSD: p=0.0001; means: 2.91% vs. 32.32%). Respondents selected more incorrect responses between the 'easy' and 'hard' question categories (LSD: P=0.001; means: 18.36% vs. 46.17%) but the number of incorrect answers did not differ between the 'easy' and 'medium' categories (P>0.05). Key areas where participant knowledge was poor included recommended forage to concentrate ratio (52.71% incorrect), identification of the signs of colic (41.09%) and recommended shoeing interval (49.46% incorrect). These results suggest a lack of fundamental knowledge exists in these horse owners, which has the potential to negatively impact equine health and welfare. Further research is needed to identify if this is a universal phenomenon in the equine industry and to explore strategies to educate horse owners and by association improve equine wellbeing.

Lay person message: Horse owners need to understand how to correctly care and manage the horses in their care to prevent health and welfare issues. Despite this, formal qualifications are not required before you can own a horse. We surveyed 128 horse owners using a 40 question quiz to establish their equine knowledge base. Over half the owners incorrectly answered medium and hard questions, and poor knowledge regarding basic nutrition and management was found. This weak knowledge base could lead to unintentional neglect or cause detrimental welfare to the horses in their care. Educating horse owners is essential to promote equine wellbeing.

Keywords: equestrian, equine wellbeing, equine welfare, equine health, horse owner knowledge.

Perceptions of the weight carrying abilities of horses and the factors that impact on this

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Over recent years there have been increasing concerns over rider weight. Whilst clearly a sensitive subject, the potential effects on equine welfare support further research in this area and it is important to understand human perceptions, as a proxy measure for practices, around horse weight carrying capabilities. The current study utilised a convenient sample through an on-line survey, distributed through social media, to investigate perceptions around the weight carrying capabilities of horses. The survey was completed by 700 participants, including horse riders (n=685) and non-riders (n=15). Participants were presented with four photos of horses and were asked to estimate the maximum rider weight they believed the horse could carry. Participants were provided with information about the horse's height, age and breed but not the horse's weight. Participants were also asked, through an open question, what information they utilise to make judgements on a horse's weight carrying capabilities. Responses to the open question were thematically analysed to identify categories of factors considered by the participants. A wide range of values were provided for the maximum weight each horse could carry, and for one horse there was a difference of 128.2kg between the smallest value (31.8kg) given for the maximum weight the horse could carry, and the biggest value (160kg). For three out of the four horses, the median maximum weight suggested that the horses could carry was less than 15% of the horses body weight (69.85 kg (12.7%), 63.50kg (13.7%), 88.9kg (13.7%) 69.85 (15.7%)). The biggest maximum weights provided for all four horses was greater than 20% of the horse's body weight (165kg (25.4%), 160kg (29.1%), 155kg (33.4%), 150kg (33.7%)). The biggest maximum rider:horse weight ratio (33.7%) was provided for the 15.2hh 16 yr. old thoroughbred weighing 445kg. Factors such as scientific guidelines, health, fitness and conformation of the horse and experience and fitness of the rider were all raised as factors that may influence a horse's weight carrying capabilities. Whilst some suggest that horses should be expected to carry a maximum of 20% of their own body weight, there is no 'gold standard' for calculating safe rider:horse weight ratios. This perhaps explains the wide range of maximum weights provided by the participants, and some of the higher weights suggested. A range of factors are likely to impact on an individual horse's weight carrying capabilities, as supported by the perceptions of the participants of this study. Finally, these findings suggest that in some instances horses may be expected to carry weights, which could compromise their welfare.

Lay person message: Where rider weight exceeds the safe weight carrying ability of the horse, there is a potential for the horse to experience pain and/or lameness, resulting in compromised welfare. Human perceptions of the weight carrying abilities of individual horses may reflect their riding practices and were explored in the current study. Participants were asked to estimate the weight carrying abilities of four pictured horses and it was found that some of the 700 participants believed that the horses were capable of carrying weights that may have reduced their welfare.

Keywords: horse weight carrying; human perceptions; rider weight; welfare.

Understanding eventing phases effect on rider pre–competition anxiety, self confidence, pre–competitive arousal and performance

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Research shows horses react accordingly, by differentiating between riders' higher heart rates caused by anxiety versus physical exertion. Often winning margins in eventing are small, due to the mix of subjective scoring in the dressage phase and the requirement for rider attentional focus when galloping, tackling technical solid obstacles. An inappropriate aid could result in penalties or a fall, with implications for horse and rider. In comparison, anxiety in non-equestrian sports may only decrease performance. Elite performers often positively interpret cognitive and somatic anxiety, with high-levels of self-confidence and is often credited as the difference between success and failure. In equestrian sport, riders build beliefs about their abilities and their equine 'partner' to perform successfully. This study examined whether any eventing phase (dressage, show-Jumping, cross-country) was associated with somatic anxiety (SA), cognitive anxiety (CA) and self-confidence (SC), investigating the relationship between trait anxiety and precompetitive arousal intensity and direction. Additionally, using Test of Performance Strategies (TOPS) questionnaire, psychological skills used by riders in training and competition were measured, identifying correlations between strategies and self-confidence. Fifty-seven participants (52=Female, 5=Male, 18=Professional, 36=Amateur, 3=Undefined) completed the Revised Competitive Sport Anxiety Inventory-2 (CSAI-2R) measuring arousal and self-confidence. Two-way between-subjects MANOVA tests examined effect of phase on SA, CA and SC. Spearman's rank correlation tests were conducted between intensity and directional CSAI-2R scores. TOPS scores were assessed and compared against published Olympian training and competition scores for each phase. The most significant findings demonstrated the show-jumping phase had significant effect on SA and CA ($P<0.05$). There were negative correlations across all three phases for SA between intensity and direction (dressage rs (57)= -0.73, $P<0.05$); XC rs (57)= -0.54, $p<0.05$); SJ rs (57)= -0.43, $P<0.05$) and dressage showed a negative correlation for CA between intensity and direction (rs (57)= -0.50, $P<0.05$). TOPS presented different scores across phases with participants scoring lower in both contexts on goal setting, automaticity, imagery, activation and relaxation and higher in negative thinking, compared to Olympians. SA and CA were identified as debilitative sources of anxiety, and could result in muscle tension which is not conducive to effective horse-rider communication. Benefit from using psychological skills such as imagery and relaxation could increase self-confidence and interpret anxiety as facilitative, allowing riders to focus and provide unhindered aids. Practically, sports psychologists and coaches could benefit from understanding which strategies to use within each phase, enhancing selfconfidence and enabling facilitative SA in event rider performance.

Lay person message: Rider pre-competitive anxiety and self-confidence may help or hinder performance. This study investigated whether Eventing phases (dressage, show-jumping, cross-country) influenced rider pre-competitive anxiety and self-confidence negatively or positively. Results showed the show-jumping phase had the greatest negative effect on anxiety and that anxiety is debilitating to rider performance selfperception. This study identified psychological skills used by riders within each phase, comparing them to published scores of Olympians. This enables coaches to understand skills that could be used in enhancing self-confidence, helping riders use anxiety positively, become more relaxed, more focussed and to communicate with the horse more effectively under pressure.

Keywords: equestrian; pre-competitive anxiety; self-confidence; performance; eventing; arousal.

Glossary

Aid: Any of the signals used to elicit responses in horses. Rein, leg, whip and spur aids are initially learned through negative reinforcement and then transformed to light aids (light rein, light leg, voice, seat) via classical conditioning. The difference between cues and aids is that aids may vary in intensity, whereas cues are typically of the same intensity. Traditionally, the aids are divided into two groups: natural aids and artificial aids. This distinction is misleading as it refers to what is 'naturally' available to the rider, but it neither identifies nor correlates with the two learning modalities through which the horse acquires its responses to the aids.

Approach conditioning: An operant conditioning technique that reduces flight behaviours using the natural tendency of horses to investigate and approach unknown objects, in combination with systematic desensitisation. The horse is encouraged to approach the object that it is fearful of, which then retreats as the horse approaches. The horse may then be signalled to stop before it reaches its fear threshold, so that the object retreats even further. The horse is then signalled to catch up. As soon as the horse slows its approach it is deliberately stopped and this is repeated until the horse comes as close as possible to the object. The horse usually becomes increasingly motivated to investigate the object.

Blocking: A form of interference with classical conditioning; once an animal has learned that a given stimulus predicts a certain event the animal may fail to learn new associations, i.e. a second stimulus may not become a conditional stimulus because learning has been blocked by the presence of the first conditional stimulus.

Classical conditioning: The process whereby an animal learns to correlate external events, e.g. the animal is presented to a neutral stimulus (e.g. a sound) which is followed by a biologically important stimulus (e.g. a noxious stimulus such as a shock, or a positive stimulus such as food). In equitation, classical conditioning is the process where learned responses are elicited from more subtle versions of the same signal or to entirely new signals, e.g. when a horse learns to react to voice commands, visual cues, or rider seat cues.

Cognition: The mechanisms by which animals acquire, process, store and act on information from the environment. The study of cognition covers many topics such as perception, learning, memory and communication.

Conflict behaviour: Stress-induced behavioural changes that arise from conflicting motivations, especially when avoidance reactions are prevented. Conflict behaviour may be agonistic behaviours, redirected aggression or displacement activities. If the stressor is recurrent, conflict behaviour may manifest as repetition and ritualisation of original conflict behaviours. Stereotypies and self-mutilation may develop from severe, chronic or frequent stressors. In equitation, conflict behaviours may be caused by application of simultaneous opposing signals (such as go and stop/slow) such that the horse is unable to offer any learned responses sufficiently and is forced to endure discomfort from relentless rein and leg pressures. Similarly, conflict behaviour may result from incorrect negative reinforcement, such as the reinforcement of inconsistent responses or lack of removal of pressure.

Contact: The connection of the rider's hands to the horse's mouth, of the legs to the horse's sides and of the seat to the horse's back via the saddle. The topic of contact with both hand and leg generates considerable controversy relating to the pressure that the horse should endure. In classical equitation, contact with the rein and rider's leg involves a light pressure (approximately 200g) to the horse's lips/tongue and body, respectively. A heavy contact may cause progressive habituation leading to diminished reactions to rein and leg signals as a result of incorrect negative reinforcement and/or simultaneous application of the aids.

Counter-conditioning: A type of training based on the principles of classical conditioning that attempts to replace fear responses to a stimulus with more desirable responses. The term means training an animal to show a behaviour which is opposite or different to the one the trainer wish-

es to eliminate. The technique is widely used in combination with systematic desensitisation. By ensuring that the preferred behaviour is more rewarding, the animal learns to perform the new behaviour when exposed to the problematic stimulus.

Cue: An event that elicits a learned response.

Ethogram: A list of the type of behaviours performed by a species in a particular environment. The list includes precise descriptions of each behaviour. It is fundamental to any study of animal behaviour to define which behaviour types are being observed and recorded.

Ethology: The scientific and objective study of animal behaviour, usually with a focus on behaviour under natural conditions, and viewing behaviour as an evolutionarily adaptive trait.

Extinction: The disappearance of a previously learned behaviour when the behaviour is no longer reinforced. Extinction can occur in all types of behavioural conditioning, but it is most often associated with operant conditioning. When implemented consistently over time, extinction results in the eventual decrease of the undesired behaviour, but in the short-term the animal may exhibit an extinction burst.

Extinction burst: A sudden and temporary increase in the frequency or magnitude of a behaviour, followed by the eventual decline and extinction of the behaviour targeted for elimination. Extinction bursts are more likely to occur when the extinction procedure is in the early stages.

Flooding (response prevention): A behaviour modification technique where the animal is exposed to an overwhelming amount of the fear-eliciting stimulus for a prolonged period of time while avoidance responses are prevented, until the animal's apparent resistance ceases. The method is generally not recommended because there are severe risks associated with the method, e.g. injuries due to exaggerated fear reactions.

Foundation training: The basic training of a young horse to respond to aids and cues that control its gait, tempo, direction and posture for whatever purpose may be required. Foundation training may also include habituation to saddle and rider.

Freeze: The sudden alert motionless stance associated with a highly attentive reaction to an external stimulus.

Habituation: The waning of a response to a repeated stimulus that is not caused by fatigue or sensory adaptation. Habituation techniques include systematic desensitisation, counter-conditioning, overshadowing, stimulus blending and approach conditioning.

Hard/tough-mouthed: Describes horses that have habituated to rein pressure. This is generally a result of incorrect negative reinforcement and can result in learned helplessness and conflict behaviours.

HPA axis (Hypothalamic–Pituitary–Adrenal axis): An organ system comprising the hypothalamus, the pituitary gland and the adrenal gland. The activation of the HPA axis is heightened when an animal is challenged with a stressor, and HPA axis products, such as cortisol, can serve as a physiological indicator of stress in animals.

Hyper-reactive behaviour: Behaviours characteristic of an activated HPA axis and associated with various levels of arousal. Such behaviours typically involve the horse having a hollow posture and leg movements with increased activity and tempo, yet shorter strides. Hyper-reactive behaviours are quickly learned and resistant to extinction because of their adaptiveness in the equid ethogram. Behavioural evidence of hyperreactivity ranges from postural tonus to responses such as shying, bolting, bucking and rearing.

Learned helplessness: A state in which an animal has learned not to respond to pressure or pain. It arises from prolonged exposure to aversive situations or insufficient environments without the possibility of avoidance or control. It may occur from inappropriate application of negative reinforcement or positive punishment, which results in the horse being unable to obtain release from or avoid the aversive stimuli. If this continues over a period of time the horse will no longer

make responses that were once appropriate, even if they would be appropriate under the present conditions.

Negative punishment (subtraction punishment): The removal of something pleasant (such as food) to punish an undesired response and thus decrease the probability of that response.

Negative reinforcement (subtraction reinforcement): The removal of something aversive (such as pressure) to reward a desired response and thus increase the probability of that response.

Operant conditioning (instrumental conditioning): The process whereby an animal learns from the consequences of its responses, i.e. through positive or negative reinforcement (which will increase the likelihood of a behaviour), or through positive or negative punishment (which will decrease the likelihood of a behaviour).

Overshadowing: The effect of two signals of different intensity being applied simultaneously, such that only the most intense/relevant will result in a learned response. It can explain why animals sometimes fail to associate the intended cue with the desired behaviour in favour of a different stimulus that was happening unintentionally at the same time and which was more relevant to the animal. The term overshadowing also denotes a desensitisation technique where habituation to a stimulus is facilitated by the simultaneous presentation of two stimuli that elicit a withdrawal response (such as lead rein cues/pressure and clippers or a needle).

Positive punishment (addition punishment): The addition of something unpleasant to punish an undesired response and thus decrease the probability of that response. Incorrect use of positive punishment can lower an animal's motivation to trial new responses, desensitise the animal to the punishing stimulus and create fearful associations.

Positive reinforcement (addition reinforcement): The addition of something pleasant (such as food or a pleasant scratch) to reward a desired response and thus increase the probability of that response.

Punishment: The process in which a punisher follows a particular behaviour so that the frequency (or probability) of that behaviour decreases. See also Positive punishment and Negative punishment.

Reinforcement: The process in which a reinforcer follows a particular behaviour so that the frequency (or probability) of that behaviour increases. See also Positive reinforcement and Negative reinforcement.

Reinforcement schedule: The frequency of the reinforcers used in training. The schedule may be continuous, intermittent or declining.

Reinforcer: An environmental change that increases the likelihood that an animal will make a particular response, i.e. a reward (positive reinforcer) or removal of an aversive stimulus (negative reinforcer).

- *Primary reinforcer*: A stimulus that is considered naturally rewarding (e.g. food).
- *Secondary reinforcer*: A stimulus that has become associated with a rewarding stimulus and thus has been conditioned to be rewarding for the horse (e.g. the sound of a clicker which has been associated with a food reward).

Shaping: The successive approximation of a behaviour toward a targeted desirable behaviour through the consecutive training of one single quality of a response followed by the next.

Stereotypy: A repeated, relatively invariant sequence of movements that has no function obvious to the observer. Stereotypies are abnormal behaviours and are generally considered as a sign of impaired welfare. Stereotypic behaviour arises from frequent or chronic stress and may help the animal to cope with adverse conditions. The behaviours may persist even if the triggering factors are eliminated. A number of stereotypic behaviours, such as box-wandering, pacing and crib-biting are seen in horses and are erroneously referred to as stable vices.

Stimulus blending: A desensitisation technique that uses a closely resembling stimulus, to which the horse is already habituated, to systematically desensitise the horse to the fear-inducing

stimulus. The fearinducing stimulus is applied simultaneously with the known, non-fear-inducing stimulus, and then systematically increased in intensity. The aural and tactile characteristics of the two stimuli are gradually mixed, making identification of the new one difficult and different. The old benign stimulus can then be diminished and finally terminated after which the horse will show habituation also to the new stimulus.

Stimulus control: The process by which a response becomes consistently elicited by a light aid or cue.

Stress: Stress is a state which is characterised by the behavioural and physiological responses elicited when an individual perceives a threat to its homeostasis ('internal balance'). The threat is termed a stressor.

Stressor: Anything that disrupts homeostasis, e.g. physical and psychological threats incl. lack of fulfilment of natural behavioural needs. Stressors appear to be stressful to the extent they contain elements of loss of control, loss of predictability, and absence of outlets for frustration.

Stress response: The body's adaptations evolved to re-establish homeostasis. Stress responses are elicited when an animal anticipates or faces a stressor and involves a range of endocrine and neural systems. The responses are somewhat non-specific to the type of stressors that trigger them. Stress responses are in nature adaptive; however, when these responses are provoked for a long duration or repeatedly, they can cause negative effects such as increased susceptibility for diseases, gastric ulceration, abnormal behaviour, reproduction problems and reduced performance.

Systematic desensitisation: Systematic desensitisation is a commonly used behaviour modification technique for the alleviation of behaviour problems caused by inappropriate arousal. In a controlled situation, the animal is exposed to low levels of the arousing stimulus according to an increasing gradient, until habituation occurs. An increase in the level of the stimulus is not made until the animal reliably fails to react to the previous level. In this way, the technique aims to raise the threshold for a response. The decrease in arousal can be reinforced by either negative or positive reinforcement.

THE QUADRANT OF REINFORCEMENT AND PUNISHMENT

	Reinforcement Increases the likelihood of a behaviour	Punishment Decreases the likelihood of a behaviour
Negative (Subtraction)	The removal of an aversive stimulus to reward a desired response Ex. Rein tension is app!ied until the horse stops and the remova! of the tension rewards the stopping response.	The removal of a desired stimulus to punish an undesired response Ex. The horse begs for food but food is withhe!d unti! the behaviour ceases.
Positive (Addition)	The addition of a pleasant stimulus to reward a desired response Ex. The horse approaches when ca!!ed for and receives a carrot.	The addition of an aversive stimulus to punish an undesired response Ex. The horse bites and receives a s!ap on the muzz!e.

Original source of the glossary: McGreevy, P. D., McLean, A. N., Warren-Smith, A. K., Waran, N., Goodwin, D. (2005) 'Defining the terms and processes associated with equitation'. In *Proceedings of the 1st Internationa! Equitation Science Symposium*, Australian Equine Behaviour Centre, Melbourne, Australia, 10– 43.

"The main study to be conducted is on the horse's mouth because the actions made on it are the most painful and can modify the whole natural balance of the horse."

(Carlo Giubbilei, "Federico Caprilli, Life and Writings", p. 91)

A quick guide to statistics for non–scientists

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The 'scientific process' comprises the six steps listed below. The application of statistics is a tool which enables reliable conclusions to be reached and the research objective to be answered. Statistical analysis is not that difficult and simply involves following a series of simple steps and rules. An example is used to demonstrate the steps required for a simple scenario where the researcher needs to apply the two sample t test in order to statistically assess the difference between two sets of data. (All text relating to the example given is highlighted with grey shading.)

EXAMPLE: A study is planned to investigate the success of dressage horses trained using two different training methods (Method A and Method B)

1. Generating a research question

A good project will have a simple title which clearly describes the objective of the study.

Is there a difference in the success of dressage horses trained using Method A and Method B?

2. Identifying variables and measures

There are two types of variables – independent variables which are determined by the researcher and dependent variables which provide the measurements upon which statistical tests are conducted.

The Independent Variable is 'Training method' and has two levels:

3. Formulating hypotheses

All research projects rely on the examination of hypotheses. Each statistical analysis relies on the simultaneous examination of a pair of hypotheses which are opposites of each other and always follow the standard format:

- The Null Hypothesis (Ho) states that '*There is no significant difference between A and B*'.
- The Alternative Hypothesis (Ha/H1) states that '*There is a significant difference between A and B*'.

Ho: There is no significant difference in the dressage scores achieved by horses trained using Method A and the dressage scores achieved by horses trained using Method B.
Ha: There is significant difference in the dressage scores achieved by horses trained using Method A and the dressage scores achieved by horses trained using Method B.

4. Designing the experiment ~ data collection

When designing an experiment it is important to obtain a decent sample size (n, as a rough guide is that anything less than 30 is considered to be a 'small' sample) and to match everything about the individuals contributing to each sample as evenly as possible.

All of the horse and rider combinations in this study will be competing at a similar level, and performing the same dressage test, under the same conditions.

Two types of data analysis are applied: first, exploratory, descriptive analysis which provides averages and an indication of the spread of the data; and second, confirmatory statistical analysis which yields 'test statistics' and probabilities and ultimately allows a statistical

conclusion to be reached. The latter will then allow a conclusion to be reached in relation to the objective of the study.

Sample data (Dressage scores, %)	
Method A	60 60 60 50 64 56 55 56 48 44 53 53 59 54 57 52 52 59 56 61 55 50 58 56 52 62 53 67 58 51
Method B	60 73 69 67 72 67 65 64 64 72 64 72 61 68 70 74 61 63 66 68 66 72 70 68 55 87 60 66 68 69 183

Exploratory, descriptive analysis ~ of the sample data shows that horses trained using Method A achieve an average score of 55.7% with a variability of 4.93% typically presented as 55.7±4.93%. Horses trained using Method B achieved a higher score of 67.4±5.80%.

At this point the general impression is gained that there is a difference in the scores achieved by horses trained using the two different training methods.

Confirmatory, statistical analysis ~ is necessary in order to reach a reliable conclusion. A standard process is now followed:

- Conduct a statistical test (here the two sample t test). This will produce a test statistic and a probability value, P.

6. Reach a conclusion

In statistics there is a one important number: **P=0.05**.

A P value of 0.05 means that if a study was repeated 100 times then 95 times out of 100 the same result would be found, and 5 times out of 100 the opposite result would be gained. As far as interpretation of results goes, the P value should be less than 0.05 in order for the results to be considered to be reliable.

In order to reach a statistically sound conclusion, a simple procedure is followed to relate the P value to the hypotheses:

- If the P value obtained is less than 0.05, the Ha is accepted and the Ho is rejected. The conclusion is then reached that there is a significant difference between the two samples. The averages found in exploratory data analysis show that training Method B is more successful than Method A.

If the P value obtained is equal to, or greater than, 0.05, the Ho is accepted and the Ha is rejected. The conclusion is then reached that there is not a significant difference between the two samples. (Here scientists state that there is a non-significant difference).

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