7th International Equitation Science Conference

Academy Bartels - Hooge Mierde - The Netherlands

27th - 29th October 2011

www.equitationscience.com

International Society for Equitation Science

CONFERENCE PROCEEDINGS

Edited by:

Dr. Machteld van Dierendonck

Drs. Patricia de Cocq

Dr. Kathalijne Visser

THEME:

Equitation Science: principles and practices - science at work

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Presents:

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Arnd

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General information

Welcome

The 7th International Equitation Science Conference will be held at Academy Bartels, Hooge Mierde, the Netherlands. Since 10 years the Global Dressage Forum has been organised at the Academy, in close cooperation with the International Dressage Trainers Club (IDTC) and the International Equestrian Federation (FEI). In 2011 the two conferences will be partners, sharing the same facilities in the same week.

The conferences of the International Society for Equitation Science (ISES) are being organised by a group of equine scientists and veterinarians who share the view that the horse-human dyad will undeniably benefit from the application of objective research and advanced practices. ISES conferences give the opportunity to present new scientific results and discuss their potential applicability in equine sports.

With the pleasure to partner this year's conference to the Global Dressage Forum, the theme of the 7th annual conference was chosen to be 'Principles and Practices – Science at Work'. With this theme, which was gratefully borrowed from the work of Professor Daniel Mills, we aspire to take another step forward in bringing equine scientists and equine practitioners nearer. We are very pleased to have four renowned keynote speakers in the programme: Professor Daniel Mills, Drs George de Jong, Professor Hilary Clayton and Professor René van Weeren. Additionally, at the practical day, we are very excited to have demonstrations from Kyra Kyrklund and Rob Ehrens.

Several people have been involved in organising this year's conference. Different working groups have shown a tremendous effort and time to make this all possible. The Scientific Committee (chaired by Machteld van Dierendonck) has received 118 abstracts which were submitted through the submission system of Wageningen Academic Publishers. All abstracts were reviewed by a minimum of two reviewers from the Scientific Committee. The Media Committee (chaired by Fenna Westerduin) has prepared and distributed over a thousand flyers and posters and numerous news items and columns worldwide. The Sponsor Committee (chaired by Mirella van Leeuwen and Gijs Bartels) has succeeded in getting the main sponsors on board. We gratefully thank our sponsors and funding bodies for making this conference possible.

The proceedings, which are produced by Wageningen Academic Publishers, contain the full programme of the three days ISES conference, abstracts of invited as well as the contributing speakers, including posters, of all sessions.

The programme is very interesting and we trust to have a wonderful and inspiring meeting in Hooge Mierde, the Netherlands. We hope you find this book a useful reference source as well as a reminder of a good meeting during which a large number of people actively involved in equitation science and practice did meet and exchanged ideas.

Kathalijne Visser *and Joep Bartels*
(Chair Local Conference Organising Committee) (Academy Bartels)

Welcome

This year, ISES has taken another step forward and closer to the heartland of equine performance sports – ISES is pleased to partner the Global Dressage Forum at Hooge Mierde, The Netherlands. On behalf of the ISES council, I would like to welcome you all to this beautiful setting at Academy Bartels and to the next stage of the ISES journey. We very much hope you find it not only edifying and exhilarating but also very moving as science edges closer to understanding interactions that span around 3 millennia. My sincere thanks to Kathalijne Visser, Machteld van Dierendonck and the local committee for their untiring efforts and I am especially grateful to the Bartels family of Academy Bartels for their willingness to collaborate.

Andrew McLean
Honorary President, ISES

The 7th ISES conference and the pre-conference Popular Equitation Science Day are organised by

Local Conference Organising Committee

Chair	Dr. Kathalijne Visser (Wageningen UR Livestock Research, NL)
Co-chair	Dr. Machteld van Dierendonck (Equus Research; Utrecht University, NL)
Finances	Drs. Fenna Westerduin (Nederlands Hippisch Kenniscentrum (Dutch Equine Knowledge centre); University of Applied Sciences HAS Den Bosch, NL)
Practical organisation	Mirella van Leeuwen (Academy Bartels, NL)
Academy Bartels	Gijs Bartels (Academy Bartels, NL)

The conference could not have been organised without the help of (in alphabetical order):

- Anne Knoops (Academy Bartels, NL)
- Carolien Munster (Moxie Sport; Utrecht University, NL)
- Cees van Beckhoven (Heart for Horses, NL)
- Elke Hartmann (Swedish University of Agricultural Sciences, SE)
- Inga Wolframm (Van Hall Larenstein – Wageningen University, NL)
- Joep Bartels (Academy Bartels, NL)
- Patricia de Cocq (University of Applied Sciences HAS Den Bosch; Wageningen University, NL)
- All other members of the Bartels Family and employees of the Academy Bartels
- The students helping during the conference days

Scientific Committee

ISES History

Andrew McLean, PhD
Honorary President ISES, Director Australian Equine Behaviour Centre, Australia

The formation of the International Society for Equitation Science is a great step forward for a scientific understanding of human/horse interactions and is a direct result of the growing worldwide interest in this area among equestrian professionals and academics alike. Our mission 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. ISES adopts ethical guidelines of the International Society for Applied Ethology (ISAE) which can be viewed on the following link: http://www.applied-ethology.org/ethicalguidelines

As a scientific discipline, Equitation Science evolved congruently in a number of contexts over the last few decades. Moyra Williams, a clinical psychologist, research scientist and keen horsewoman penned the first books that attempted to explain aspects of horse behaviour scientifically: *Practical Horse Psychology* (1973) and then *Horse Psychology* (1976). In her books she explained mankind's best yet extant understanding of aspects of equine cognition such as urges and instincts; self-protection; sex and reproduction; socialization and company; curiosity; how horses perceive colour, shape, size and movement; senses of smell, hearing, touch and time; how a horse learns and solves problems; the horse's memory; temperament and character; and causes and treatment of vices (sic). Moyra's work was ground-breaking, and her books were closely followed by other scientific texts such as Marthe Kiley-Worthington's *Behaviour of Horses* and Lucy Rees' *The Horse's Mind*. However, until this point, few scientific journals and even fewer texts revealed in any detail the learning processes behind horse training. In 1997 Paul McGreevy published *Why Does My Horse...?* where he explained many behaviour problems in terms of learning theory. At that time, Andrew McLean was in the midst of his PhD in which he explored the mental processes of the horse and their implications to horse training. Andrew had been writing in the lay press on problem behaviours and their origin largely in the incorrect use of negative reinforcement and as a consequence, he and Paul discussed academic collaboration in early 2002.

Then, later in 2002, along came the Havemeyer Foundation Workshop on Horse Behaviour and Welfare in Iceland. During this workshop, discussions on horse training and welfare between Debbie Goodwin, Natalie Waran and Paul McGreevy revealed their own feelings of urgency for a scientific base for horse people to understand horse behaviour and training. Thus they virtually sealed the inevitability of a new scientific discipline: Equitation Science. It was then arranged that Andrew be invited to present his PhD findings to a satellite meeting on horse welfare at the 2003 International Society of Applied Ethology Congress in Italy, initiated and organised by – among others – Machteld van Dierendonck. Consequently, the first workshop on Equitation Science was held the following year at Edinburgh University Veterinary School in 2004 where Andrew gave 3 practical demonstrations of the application of 'learning theory' in-hand and under-saddle. As a result of the growing interest in Equitation Science, it was decided to launch the first Symposium in Equitation Science at the Australian Equine Behaviour Centre (AEBC) the following year. Thus the 1st International Equitation

Science Symposium was inaugurated in August 2005, when 8 peer-reviewed research presentations and discussions were conducted at the AEBC in Australia.

The 2^{nd} International Equitation Science Symposium was arranged Michaela Minero and Elizabetta Canali in Italy at the University of Milan Veterinary School in 2006 with 15 peer reviewed papers and 11 posters and practical demonstrations at the Equestrian Centre and Equestrian Museum of the Luxardo family. In August 2007 the 3^{rd} International Equitation Science Symposium was hosted by Camie Heleski of Michigan State University, USA. This was an historic meeting that hosted the first General Meeting of the Society at the Kellogg Centre, Michigan State University on the 15^{th} of August 2007.

ISES was truly born and Symposia soon transformed into Conferences. In order to recognise the earlier 3 Symposia the ISES Symposium of 2008 was to be held at the Royal Dublin Society in Ireland and renamed the 4^{th} ISES Conference. 2009 saw the 5^{th} ISES Conference return to Australia to the University of Sydney Veterinary School and then in 2010 the 6^{th} ISES Conference met in Uppsala in Sweden.

What is ‘science’? – Benefits & limitations

Camie R. Heleski, PhD
Department of Animal Science, Michigan State University, USA

What does the term ‘science’ mean to you? It’s not as easy to define as one might think, is it? We use the word so often we tend not to think about it. Science comes from the Latin word, *scientia* meaning knowledge. Wikipeda says science is a systematic approach that builds and organizes knowledge in the form of testable explanations and predictions. Further, Wikipedia goes on to state that to be termed scientific, a method of inquiry must be based on gathering measurable evidence subject to specific principles of reasoning. When following ‘the scientific method’ a researcher will follow (approximately) the following steps: formulate a question (for example, can horses understand the difference between harsh tones and soothing tones when given human vocal cues?), perform background research/make preliminary observations, construct a hypothesis (for example, ‘we hypothesize that horses will perform a learning task more quickly when given supplemental vocal cues in a soothing tone as compared to a harsh tone’), test your hypothesis by performing a carefully designed experiment, analyse the data with sound methodology, arrive at justifiable conclusions, then communicate the results.

So what does this mean in the relatively young field of Equitation Science? On the one hand, it means that the profile of Equitation Science has been raised significantly during the last decade due to an emphasis on measuring the objective, quantifiable aspects of horse-human interactions. For example, we can use rein tension gauges to objectively measure how much tension is taking place between the bit and the rider’s hands during different riding exercises. This coupled with carefully monitoring the horse’s behaviour in response to different rein tensions begins to give us an understanding of which tensions are perceived more or less positively by the horse. We might further add to the rigor of this type of experiment by also measuring heart rates and, perhaps, cortisol levels.

But just because we can utilize quantifiable measurements that are repeatable by other scientists, does this automatically benefit the horse’s welfare? Does it automatically answer our initial question? For example, what of horses that have already become habituated to high levels of rein tension over many years of being ridden in that manner? They may show no significantly aversive behaviours as compared to a horse ridden with a lighter hand, they may show no significantly different cortisol levels or heart rates as compared to the more lightly ridden horse. Does that give us an automatic ‘green light’ to proceed with relatively high tension riding? In my mind, it does not.

There is an important interplay between scientific scrutiny and ethical assessment that must take place if we truly wish to enhance the horse’s well being in its interactions with us. Scientific evaluation and ethical assessment should not be at odds with one another; rather they should complement one another. As stated in last year’s conference of this same meeting, science without ethical assessment can be problematic, but so can ethical assessment (or kneejerk assumptions) without scientific study.

Horses are a highly adaptable species. If we stall them individually for 23 1/2 hrs per day in a solid walled box stall, exercise them for 1/2 hr/day in an indoor arena, yet they show no evidence of ulcers, loss of bone density, nor stereotypic behaviour, does this make it an acceptable housing method? If we survey a warm up arena, and note the 10 most harshly handled horses in the arena (from our human perspective), yet, upon measurement, they show no measurable differences from 10 control horses, what does this tell us?

The benefits of science and its application to the field of equitation science surely outweigh its limitations, but we must always remember to keep our eyes open, watch the whole horse, listen to the whole horse and sometimes remember to trust our horsemanship instincts that brought us to this field to start with.

Global Dressage Forum

Richard Davison
Davison Equestrian, Combridge, United Kingdom

The Global Dressage Forum is the leading public debating platform for the international dressage world. The world's top rider's and trainer's techniques are scrutinised and examined in both practical and theoretical sessions. Current political proposals, which impact on the dressage sport, have an airing and the latest developments in horse management and sports science are also presented.

Since October 2001 top trainers, riders, officials and serious dressage enthusiasts from around the globe meet at the annual gathering held at The Academy in Hooge Mierde, the Netherlands. The Global Dressage Forum has presented unforgettable training clinics by international and Olympic champions like Anky van Grunsven, Kyra Kyrklund, Ulla Salzgeber, Jan Brink, Johann Hinnemann, Monica and George Theodorescu, Edward Gal, Hubertus Schmidt and many others. By demonstrating with their own horses and pupils, this unique event allows an in-depth insight into what makes their methods so successful.

Respected judges from all over the world also convene at the Forum to evaluate and discuss international judging with riders and trainers. The intention of the Global Dressage Forum is to provide a medium through which a common dressage language and philosophy can evolve and spread globally.

Dressage is rightly proud of its traditional routes and history. While recognising the importance of classical riding, delegates at the Global Forum are invited to be open minded and are stimulated to explore ideas, not only with sport 'insiders' but also with experts from other sports and sports scientists.

As independent annual global convention, the Global Dressage Forum is quite unique and it's goal is to assist in the promotion and development of dressage.

Global
Dressage
Forum

Learning principles in horse training

Andrew McLean, PhD
Honorary President ISES, Director Australian Equine Behaviour Centre, Australia

‘Learning theory’ describes the body of knowledge that defines and describes all aspects of learning processes in the animal kingdom. Successful horse training and equitation implicitly rely on the animal’s learning processes. In the young horse, habituation defines the process whereby the horse learns to tolerate its habitat and surroundings including the people and animals within it, along with various paraphernalia used in equitation including saddlery, horse boots, blankets, and covers. The horse also habituates to the presence of a human on its back. Desensitisation techniques used during re-training of horses that have developed fearful reactions to innocuous stimuli utilise habituation.

All forms of horsemanship involve, at some point, the use of the rider’s legs and the reins for control of acceleration and deceleration, changing direction, and moving sideways. In-hand, the lead rein (lead line) and, by classical conditioning, the voice control the horse’s locomotory responses. In early foundation training, control is established via negative reinforcement, commonly known as ‘pressure-release.’

In negative reinforcement, the increasing pressure (including increases in frequency of whip taps) motivates the animal to trial various responses and the removal of the pressure reinforces the desired response. The timing of the release of pressure is critical to reinforcing the correct response. Poor timing of release accounts for many behavioural problems in the ridden and led horse that can manifest as conflict behaviours and may escalate into learned helplessness. The use of negative reinforcement provides an efficient mechanism for rapidly achieving control of the horse’s locomotory responses because it motivates the animal to trial a response. Despite its significance and ubiquity in horse training, research has shown that the meaning and use of negative reinforcement is mostly misunderstood by qualified Australian riding coaches. There is no reason to expect that the situation would be different in other countries.

Furthermore, the full importance of negative reinforcement has been overlooked in dressage texts throughout the centuries. For example, even though the expected effect of the reins on the horse is deceleration, a response that is undoubtedly trained by negative reinforcement, the rein effect is described without mention of pressure or release as ‘contact,’ an effect that is said to evolve during training. Contact in this context is defined currently as a quality of 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 confusion related to the pressure that the horse should endure if the contact is deemed to be correct. That said, pressure-release effects specific to the rider’s legs are more appropriately acknowledged by the contemporary and classical texts of equitation. Owing to the sensitivity of the horse’s mouth, it is likely that inappropriate training of the decelerating effects of the reins can lead to conflict behaviours, stress, and wastage. Examples of conflict behaviours include bucking, shying, rearing, swerving, leaping, and bolting.

In correct equitation, the pressures provided by the reins and rider's legs begin with the lightest pressures and smoothly but rapidly increase to a threshold that prompts a response. The initial light pressure acts as a discriminative stimulus heralding the onset of stronger pressures that approach this threshold. The subsequent release of pressure reinforces the correct response and then, through classical conditioning, the discriminative stimulus (the light aid) becomes the trigger that alters the horse's locomotion. When responses are elicited by lighter pressure signals (known as 'aids'), they are sometimes enhanced by positive reinforcement such as food or caressing. Positive reinforcement itself can be heralded by a predictive signal such as a clear sound signal (clicker or 'Good Boy!'). This is known as secondary reinforcement.

Ultimately, stimulus control of all locomotory responses, both in-hand and under-saddle, should be achieved via these light aids: the diminutive version of the original rein or leg pressures. Further discriminative stimuli, such as the seat, posture, and voice, can achieve stimulus control. Again, these are acquired through the process of classical conditioning.

It is important to recognise the characteristics of 3 phases of training and the different mechanisms of learning (negative reinforcement and classical conditioning) they use. Although desirable responses can be classically conditioned, many undesirable responses can also emerge if the basics are not established unequivocally by operant conditioning. The 3 phases of training can be summarized as follows:

- Phase 1 – Trial-and-error (operant) learning where the horse learns the correct response to the pressure stimulus.
- Phase 2 – Shrinking the pressures used in pressure-release training so that they become light versions of the same stimuli; responses are now under stimulus control.
- Phase 3 – Classical conditioning of light signals to other unrelated cues; this is the phase where new cues achieve stimulus control.

All equestrian disciplines involve progressive improvements in responses deemed correct and desirable by trainers. These improvements are the result of the process of *shaping*. Shaping can be defined as the successive approximation of behaviour toward a targeted desirable behaviour through the consecutive training of one single quality of a response followed by the next. In European and traditional 'English' equitation, shaping involves the gradual refinement of responses culminating in a ridden horse that gives the impression of a free, rhythmically moving horse with a 'rounded' outline that follows the rider's line and cues with precision and without tension or resistance. These characteristics involve the progressive shaping of the following qualities:

1. Reinforcing the correct locomotory responses through trial and error learning (principally negative reinforcement).
2. Placing the locomotory responses under the stimulus control of the discriminative stimuli of the appropriate light signals of the rein(s), lead, or rider's leg(s).
3. Achieving desired responses within a distinct time-frame and locomotory structure.
4. Achieving persistence of rhythm and tempo of locomotory responses.
5. Achieving persistence of line and directional locomotory responses.
6. Achieving persistence of the horse's head, neck, and body postures.
7. Achieving all of the above qualities in different environments ensuring that the horse is consistently under the rider's or handler's stimulus control in the face of other aversive and potentially controlling or overwhelming stimuli.

For optimal learning, unrealistically large incremental improvements should not be expected and shaping must use consecutive steps so that the horse is not overwhelmed by inappropriate demands that can contribute to stress and possibly learned helplessness.

(Adapted from: Roles of Ethology and Learning Theory in Equitation [McGreevy and McLean, 2005, Journal of Veterinary Behaviour (2007) 2, 108-118])

Does your training system stand the test of science?

The following 8 principles were originally defined in the peer-reviewed scientific literature (McGreevy and McLean, 2007 – *The roles of learning theory and ethology in equitation.* Journal of Veterinary Behaviour: Clinical Applications and Research, Volume 2, 108-118).

The application of these principles is not restricted to any single method of horse-training, and we do not expect that just one system will emerge. There are many possible systems of optimal horse-training that adhere to all of these principles.

First principles in horse-training

1. Understand and use learning theory appropriately

Learning theory explains positive and negative reinforcement and how they work in establishing habitual responses to light, clear signals. (Note that 'positive' and 'negative' when applied to reinforcement are not value judgements, as in 'good' or 'bad', but arithmetical descriptions of whether the behaviour is reinforced by having something added or something taken away, e.g., pressure. For example, when the horse responds to a turn signal and the rein pressure is immediately released, negative reinforcement has been applied.)

It is critical in the training context that the horse's responses are correctly reinforced and that the animal is not subjected to continuous or relentless pressure. Prompt and correct reinforcement makes it more likely that the horse will respond in the same way in future. Learning theory explains how classical conditioning and habituation can be correctly used in horse-training.

2. To avoid confusion, train signals that are easy to discriminate

There are many responses required in horse-training systems but only a limited number of areas on the horse's body to which unique signals can be delivered.

From the horse's viewpoint, overlapping signal sites can be very confusing, so it is essential that signals are applied consistently in areas that are as isolated and separate from one another as possible.

3. Train and shape responses one-at-a-time (again, to avoid confusion)

It is a prerequisite for effective learning that responses are trained one-at-a-time.

To do this, each response must be broken down into its smallest possible components and then put together in a process called 'shaping'.

4. Train only one response per signal

To avoid confusing the horse, it is essential that each signal elicits just one response. (However, there is no problem with a particular response being elicited by more than one signal.)

Sometimes a response may be complex and consist of several trained elements. These should be shaped (or built up) progressively. For example, the ‘go forward’ response is expected to include an immediate reaction to a light signal, a consistent rhythm as the animal moves in a straight line and with a particular head carriage. Each of these components should be added progressively within the whole learned response to a ‘go forward’ signal.

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5. For a habit to form effectively, a learned response must be an exact copy of the ones before

For clarity, a complete sequence of responses must be offered by the horse within a consistent structure (e.g., transitions should be made within a defined number of footfalls).

Habit formation applies to transitions in which the number of footfalls must be the same for each transition and this must be learned.

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6. Train persistence of responses (self-carriage)

It is a fundamental characteristic of ethical training systems that, once each response is elicited, the animal should maintain the behaviour.

The horse should not be subjected to continuing signals from leg (spur) or rein pressure.

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7. Avoid and dissociate flight responses (because they resist extinction and trigger fear problems)

When animals experience fear, all characteristics of the environment at the time (including any humans present) may become associated with the fear. It is well-known that fear responses do not fade as other responses do and that fearful animals tend not to trial new learned responses.

It is essential to avoid causing fear during training.

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8. Benchmark relaxation (to ensure the absence of conflict)

Relaxation during training must be a top priority, so when conflict behaviours are observed in the horse, we must carefully examine and modify our training methods so that these behaviours are minimised and ultimately avoided.

To recognise the importance of calmness in enabling effective learning and ethical training, any restraining equipment, such as nosebands, should be loose enough to allow conflict behaviours to be recognised and dealt with as they emerge.

Time table

Wednesday October 26, 2011 (*Van der Valk hotel, Eindhoven*)

Time		
18:00	Registration open	
18:00	Welcome reception	

Thursday October 27, 2011 (*Academy Bartels, Hooge Mierde*)

Time		
08:00	Registration open	
09:00	Introduction and welcoming	
	Theme – Session 1 – Understanding of Equine Behaviour – 1 *Chaired by Hayley Randle*	
09:45	***Plenary lecture**:* pg 1 **Equitation and problem behaviour in the horse – principles and practices**	**Prof. dr. D.S. Mills**
10:35	*Poster teasers 1-12 – Chaired by Marc Pierard*	
11:00	Coffee break & Posters	
	Theme – Session 1 – Understanding of Equine Behaviour – 2 *Chaired by Inga Wolframm*	
11:30	*Review presentation*: pg 9 Review of the forensic aspects of equine abnormal behaviour and vices.	M. Sloet Van Oldruitenborgh-Oosterbaan
11:55	*Research presentation*: pg 10 Stress response of three-year-old mares to changes in husbandry system associated with equestrian training	R. Fischer
12:10	*Research presentation*: pg 11 Life experience and object-directed emotions in horses	P. Baragli
12:25	*Research presentation*: pg 12 Evidence for differences due to gender in manageability of yearling horses	M. Wulf
12:40	*Poster teasers 13-22 – Chaired by Marc Pierard*	
13:00	Lunch break & Posters	

	Theme – Session 2 – Motivation horse and rider *Chaired by Orla Doherty*	
14:00	***Plenary lecture**:* pg 3 **Stimulating innovation in sport and bringing knowledge and applied sport closer together**	**Drs. G. de Jong**
14:50	*Review presentation*: pg 20 Assessment of ridden horse behaviour	C. Hall
15:15	*Research presentation*: pg 21 Whipping of Australian Thoroughbred racehorses in the penultimate 200 metres of races is influenced by jockeys' experience	P. McGreevy
15:30	*Research presentation*: pg 22 Do dressage and show jumping riders in Sweden differ in perception of optimal horse temperament?	M. Axel-Nilsson
15:45	Coffee break & Posters	
16:15	*Research presentation*: pg 23 Comparison of heart rate response to natural and conventional training methods in Purebred Arabian colts and fillies	W. Kędzierski
16:30	*Research presentation*: pg 24 The development of a mental skills inventory for equestrian riders	I.A. Wolframm
	Theme – Session 3 – Free papers *Chaired by Elke Hartmann*	
16:45	*Research presentation*: pg 33 Horses' ability to learn an instrumental task by observation	L.P. Ahrendt
17:00	*Research presentation*: pg 34 Behaviour and stress responses in horses with gastric ulceration	J. Malmkvist
17:15	*Research presentation*: pg 35 A comparative study of pirouettes practised in the warm-up and subsequent performance in an elite (Grand Prix) level dressage competition	A.A. Mills
17:30	*Poster teasers 23-32- Chaired by Marc Pierard*	
17:50	Drinks & Posters Possibility to have guided tour Academy Bartels	
19:30	Informal Dutch Dinner (included in the registration fee) With … Surprise show !	

Friday October 28, 2011 (Academy Bartels, Hooge Mierde)

Time		
08:00	Registration	
	Theme – Session 4 – Human – Horse Interaction – 1 *Chaired by Paul McGreevy*	
09:00	***Plenary lecture****:* pg 5 **Horse-rider interaction via the reins**	**Prof. dr. H.M. Clayton**
09:50	*Review presentation*: pg 49 Review on biomechanical interaction between horse and rider.	P. de Cocq
10:15	*Research presentation*: pg 50 Heart rate, heart rate variability, salivary cortisol concentration and superficial body temperature in horses lunged with hyperflexion of the neck	C. Aurich
10:30	*Research presentation*: pg 51 The link between performance and heart rate in a known vs. novel environment	J. Winther-Christensen
10:45	*Research presentation*: pg 52 A comparison between the Monty Roberts technique and a conventional UK technique for initial training of riding horses	V.L. Fowler
11:00	Coffee break & Posters	
	Theme – Session 4 – Human – Horse Interaction – 2 *Chaired by Frank Ödberg*	
11:30	*Research presentation*: pg 53 Pressure distribution beneath conventional and treeless saddles	H.M. Clayton
11:45	*Research presentation*: pg 54 The use of the investigative behaviour to improve the training of the jumping horse	A. Telatin
12:00	*Research presentation*: pg 55 The effect of type of bit on behaviour and performance of horses	K. van der Horst
12:15	*Research presentation*: pg 56 The effect of primary positive reinforcement administered by a TriggerTreater TM on the learning ability of the ridden horse.	S.J. Lloyd
12:30	*Research presentation*: pg 57 Horse training: Is there a difference between positive and negative reinforcement concerning effectiveness and stress related symptoms?	K. Elmgreen
12:45	*Research presentation*: pg 58 Deciphering the cues from riders' legs.	L. Hawson

13:00	Lunch break & Posters	
	Theme – Session 5 – Horse based Parameters – 1 *Chaired by Natalie Waran*	
14:00	***Plenary lecture***: pg 7 **Facts, figures & fiction about flexion**	**Prof. dr. René van Weeren**
14:50	*Review presentation*: pg 77 A review of early exercise in the horse	C.W. Rogers
15:15	*Research presentation*: pg 78 Two estimates of consistency in judging dressage competitions	A. Stachurska
15:30	*Research presentation*: pg 79 The impact of maternal equine appeasing pheromone on cardiac parameters during a cognitive test in saddle horses after transport	A. Cozzi
15:45	*Research presentation*: pg 80 Towards a welfare monitoring system for horses in the Netherlands: prevalence of several health matters	F. Neijenhuis
16:00	Coffee break & Posters	
	Theme – Session 5 – Horse based Parameters – 2 *Chaired by Michela Minero*	
16:30	*Research presentation*: pg 81 Comparison of heart rate, lactate and velocity between training and competition in 3- to 4-star eventing horses	S. Martens
16:45	*Research presentation*: pg 82 Objective detection of locomotion asymmetry using a 3D inertial sensor gait analyses-system in sound horses	L.C. Hardeman
17:00	*Research presentation*: pg 83 Quantifying stress in experienced and inexperienced mounted police horses, using heart rate, heart rate variability, behaviour score and suitability score	C. Munsters
17:15	*Research presentation*: pg 84 The effect of noseband tightness on rein tension in the ridden horse	H. Randle
17:30	Wrap up of two days of oral presentations	
18:00	Drinks & Posters	
19:30	Conference dinner Surprise show, including Frisian horses	

Saturday October 29, 2011 (Academy Bartels, Hooge Mierde)

Time		
08:00	Registration open	
	Practical day 'Science meets Top Sport' Moderators: *Richard Davison & Andrew McLean*	
09:00	**Introduction and welcome**	
09:05	*Oral presentation*: Introduction and history of ISES pg X	Andrew McLean
09:25	*Oral presentation*: Introduction and history of GDF pg XIV	Richard Davison
09:45	*Oral presentation*: What is 'science' – benefits and limitations pg XII	Camie Heleski
10:05	**Workshops innovations in science and practice**	
	Mounted police at work	LARGE RIDING HALL
	Big Brother is watching you!	LIBRARY
	How do elite riders do it?	SMALL RIDING HALL
12:00	*Panel discussion morning workshops*	
13:00	Lunch break & Posters	
14:00	Clinics	
14:00	Introduction 8 principles	
14:15	**Dressage Clinic**	Kyra Kyrklund
15:00	Coffee break & Posters	
15:30	**Show-jumping Clinic**	Rob Ehrens
16:15	*Panel discussion afternoon clinics*	
17:00	Closing remarks Practical day	
17:15	Closing Conference	
17:30	Drinks & Posters	

Biographies of plenary speakers and clinic presenters

Prof. Daniel Mills, PhD

Professor dr. Daniel Mills became the first specialist in veterinary behavioural medicine to be recognised by the Royal College of Veterinary Surgeons, is Director of the Animal Behaviour Referral Clinic of the University of Lincoln and Programme leader of their MSc in Clinical Animal Behaviour. Together with colleagues at the University, he has pioneered the development of an approach to problem behaviour management which focuses on an evidence based evaluation of the emotional state of the subject and the humane reconciliation of conflicting interests between animal and owner. He was a founder of the biennial international meetings, which have assisted in shaping the veterinary behaviour profession, and is a passionate communicator of science in the interests of animal welfare. To this end he frequently speaks internationally and publishes in both the popular and scientific literature on equine behaviour and management. He is principal author of the text 'Equine Behaviour, Principles and Practice', co-editor of 'the Domestic Horse' and editor-in-chief of 'The Encyclopaedia of Applied Animal Behaviour & Welfare'. His research has led to the wider use of stable mirror to assist horses with isolation problems and is now helping to understand the biology of repetitive behaviour problems, especially weaving, crib-biting and headshaking, with a view to developing more efficient intervention strategies for the individual.

George de Jong

George de Jong (1953) completed his Physical Education studies in Groningen (Netherlands) in 1976. In 1988 he completed his Masters Sports Management in Mobile (USA). In 1982 George moved to Switzerland where he worked as a Sports Manager and Volleyball Coach. In 1989 he was appointed as Technical Director of the World Volleyball Federation (FIVB) in Lausanne (Switzerland), responsible for the collaboration with Continental and National Federations on technical matters, player transfers and the preparation of World and Olympic championships. The Integration of Beach volleyball in the Olympics was considered an important success in 1994. From 1995 up to September 2008 he held the position of Director of the Royal Dutch Equestrian Federation (KNHS) in Ermelo (Netherlands) and its predecessor, the Dutch Equestrian Federation (NHS). In 2002 he, together with his board, completed the merger of 17 Dutch equestrian organisations into the new KNHS. Within the KNHS he focused on marketing and communication, top sports, and international affairs. He was the Chef de Mission of the Dutch Olympic Equestrian Team in Atlanta 1996, Sydney 2000 and Athens 2008. George is one of the creators of the successful Rabobank Talent Development Plan. As chairman of the Federation Equestrian International (FEI) working group 'FEI Structure 2006-2010' he was responsible for the reorganisation plan of the FEI. George de Jong was also a member of the Advisory Board to the FEI President Princess Haya until 2010. In 2008 George received the Dutch award 'Horseman of the year'. In September 2008 George de Jong was appointed as CEO of InnoSportNL, located in Arnhem (Netherlands). InnoSportNL was founded in 2006 by TNO and NOC*NSF with the objective to stimulate and accomplish knowledge transfer and innovation in all areas of sports, including leisure and top sport. InnoSportNL consequently functions as a key mediator in the 'triangle' of sport, knowledge institutions and businesses and has partner agreements with Dutch companies and universities. As a volleyball player George played 35 matches for the Dutch national team. As head coach for VBC Leysin he won the Swiss Volleyball Championship five times. George was also head coach of the Swiss National team. He is married to Loekie Raterink, also a former Dutch volleyball international. They have two sons, Siem and Luuk, who are both professional soccer players. George is member of the board of soccer club VBV De Graafschap in Doetinchem.

Prof. Hilary Clayton, PhD

Professor dr. Hilary Clayton is a veterinarian and researcher. She held faculty appointments at veterinary colleges in Great Britain, The Netherlands and Canada before moving to Michigan State University in 1997. Her research focuses on equine sports medicine, especially biomechanics and conditioning of sport horses, the effects of physiotherapeutic techniques in horses and the interaction between rider and horse. She has published six books and many scientific manuscripts and magazine articles. Dr. Clayton is a Past President of the Association for Equine Sports Medicine, President Elect of the American College of Veterinary Sports Medicine and Rehabilitation and a member of the US Equestrian Federation's Dressage Committee. She has competed in a variety of equestrian sports and currently trains dressage horses through the Grand Prix level.

Prof. René van Weeren, PhD

Professor Paul René van Weeren (1957) graduated in 1983 from the Utrecht University Veterinary Faculty (The Netherlands). He obtained his PhD degree in 1989 and became a diplomate of the European College of Veterinary Surgeons in 1994. He was appointed a full professor to the Chair of Equine Musculoskeletal Biology in 2007 and is now mainly involved in research with focus areas articular cartilage, tendons and biomechanics. Currently he is the coordinator of scientific research of the Department of Equine Sciences of the Faculty of Veterinary Medicine of Utrecht University and a member of the Management Board of the Department. He has been a supervisor of 18 PhD students, who have obtained their degree in the past years and currently supervises 6 PhD students, who will be graduating within the next few years. He is an associate editor of *Equine Veterinary Journal* and member of the scientific board of several others. He has been external examiner for PhD students abroad at various occasions in Belgium, the UK, France, Austria, Sweden, Norway and Finland. He is author or co-author of more than 175 peer-reviewed scientific publications or book chapters.

Andrew McLean, PhD

Dr. Andrew McLean is author and co-author of a number of academic journal papers, Andrew has written and co-authored a number of books including *Equitation Science,* a peer-reviewed text that distils and demystifies learning processes in horse training. Andrew has represented Australia in Horse Trials, and has trained and competed to FEI level in Dressage and Jumping and has coached international competitors and teams. In May this year, he was invited as guest coach for the British Horse Society's Spring Coaching Convention. Andrew regularly conducts clinics throughout Australia, New Zealand, South Africa, US, Canada, Europe and the UK disseminating the application of learning theory to all disciplines of horse training and from leisure riding to Olympic competition horses, focusing on optimal welfare through a neo-classical approach to training grounded in learning theory. He has 30 years' experience in professional training and foundation training, and has developed the internationally recognised Australian Equine Behaviour Centre.

Camie Heleski, PhD

Dr. Camie Heleski is an instructor in the Animal Science department at Michigan State University & coordinates the Agricultural Technology Horse Management program. Her research interests are in the areas of horse behaviour, horse welfare, horse-human interactions & working equids in developing parts of the world. She received her M.S. in Animal Science in the area of Horse Nutrition & Exercise Physiology. In 2004, she completed her PhD in Animal Science in the area of Animal Behaviour & Welfare. Her practical horse background is that she grew up on a farm that raised Arabians and trained many different breeds of horses. As a youth, she showed horses extensively in western, huntseat and saddleseat. Currently, Camie prefers to ride dressage when given the opportunity. Camie, her husband, and her two children live on a small 'farmette' in Michigan where they keep several horses, dogs & cats.

Richard Davison

Richard Davison is leading the debate during the two days since the start of the Global Dressage Forum. Richard was a member of the British team, competed in three Olympics and many Championships, and was the chef d'equipe of the British dressage team in Hong Kong and Windsor. Major achievements: Richard won a team silver medal at the European Championships in 1993 with Master JCB and was a member of the bronze medal-winning team a decade later on home turf riding Ballaseyr Royale at the 2003 Hickstead European Championships. Richard's other equestrian involvements include being a regular columnist for Horse & Hound magazine, a television commentator, and member of the international rider and trainer clubs. He is a Fellow of the British Horse Society and holds the British Equestrian Federation's medals of honour.

Kyra Kyrklund

Kyra's career at the top of international competitive dressage spans some 30 years. As a junior rider she competed in dressage, eventing and show jumping. Kyra was a student at the Strömsholm Riding Academy in Sweden and then moved on to training in Germany with Walter Christensen and Herbert Rehbein. This gave her an appreciation of different training techniques. Kyra has successfully trained and competed 15 horses in international Grand Prix dressage. She has taken part in 6 Olympic Games (5th 3 times with Piccolo, Matador and Edinburg and 8th with Max, 19th with Nör and 28th with Amiral). She won the silver medal at the World Equestrian Games in 1990 with Matador. Kyra has taken part in 6 World Cup finals and won the final with Matador in 1991. She was 3rd with Edinburg 1994, 5th with Amiral in 1997 and 6th with Master in 1998. With Max she was 4th at the WC final in 2007 and 3rd at the final in 2008. Kyra has trained many successful international dressage riders. During her time as chief dressage trainer at Flyinge she had many illustrious students. Jan Brink with Briar, silver medallist at the Europeans at Hickstead 2003, trained with Kyra throughout their whole career. She is now supervisor for the Swedish team preparing for the Olympic Games in London 2012. Kyra's book 'Dressage with Kyra' (written together with Jytte Lemkow) has been published in 7 languages and has sold over 40,000 copies. Kyra's training DVD's are sold all over the world. Kyra's lecture demos and symposiums are very popular all over the World. She shows how she trains horses from young age up to Grand Prix level. While riding, Kyra explains and demonstrates how she uses her well-known method of treating the horses with kindness but firmness, using a logical and consistent system to obtain excellent results. This system has made her not only one of the best dressage riders in the world, but also, one of the world's most respected and admired trainers. Her successes have also resulted in being elected President of The International Dressage Rider's Club last year. In April this year she was appointed Professor in equitation (dressage) at the Swedish University of Agricultural Sciences.

Rob Ehrens

Rob Ehrens holds the role of national coach for the Dutch senior show jumping team since 2004. His most notable successes include a very successful Nations Cup competition in 2011, team gold at the World Championships in Aachen (Germany, 2006), team bronze at the European Championship in San Patrignano (Italy, 2005) and team gold at the European Championships in Mannheim (Germany, 2007). In 2007 Rob was further honoured for his achievements with the title of 'Equestrian of the Year'. From 2002 until 2004 Rob successfully coached the Dutch young riders and juniors. He is a member of the Dutch High Performance Advisory Board, holds his trainer licence as Master Coach in Sport and runs his own show jumping yard together with his wife and son. A successful competitor in his own right, Rob won the Dutch national championships three times, and between 1981 and 1998 competed regularly at European, World, and Olympic Level.

Abstracts

Equitation and problem behaviour in the horse – principles and practice

Daniel S. Mills BVSc PhD CBiol FIBiol FHEA CCAB Dip ECVBM-CA MRCVS
European & RCVS Recognised Specialist in Veterinary Behavioural Medicine
Dept of Biological Sciences, University of Lincoln, United Kingdom

Historically, both equitation and the management of problem behaviour have been performance driven activities, i.e. success has focused almost exclusively on behavioural outcome, whilst caring *for* the horse. However, the emergence of equitation science and veterinary behavioural medicine as disciplines in their own right, mean we are now in a position to elucidate the underlying processes of behavioural change, apply them in novel ways and more objectively evaluate their impact on the well-being of the horse. The emergence of these scientific disciplines has been important for those who care *about* the horse, since it means we can move from well-meaning intention to a more objective welfare orientated approach. This has led us to challenge many common practices based around the management of the horse, on the grounds of the harm they do to the interests of the animal's concerned. Accordingly there is growing demand for an ethical framework for equitation science and problem behaviour management.

An important starting point for evaluating the morality of any relationship between two sentient beings is the recognition that both participants have interests and that they will come into conflict from time to time. At this point the welfare of one or both of the individuals concerned may be compromised. The question which then arises is, how should this conflict be resolved? In moral philosophy the instrumentalisation of sentient beings (i.e. their reduction to the level of inanimate machines to serve humans) is widely viewed as ethically undesirable, and so we should take note of the interests of horses, when our interests conflict – i.e. whenever we want the horse to do something for us (which might range from a certain type of performance to living in certain conditions). This means we should not evaluate a training method or management practice simply on the basis of whether it achieves the human goal, which is often a specific change in the behaviour of the horse. Rather, we must also consider the impact of that outcome and the path to that outcome on the horse, compared to the alternatives, which might include varying degrees of compromise in our own interests. This evaluation will help us to decide the right thing to do in any given context.

This ethically sensitive approach is contingent upon understanding the principles of equitation science, equine management and behaviour change. For example in the case of repetitive behaviour, historically, many treatments focused on prevention of the behaviour often regardless of their impact on the horse's wellbeing, thus surgical procedures and collars have been recommended for crib-biting and bars or hobbles for weaving. These might stop the physical expression of the behaviour, but do not address the underlying cause and have the potential to increase frustration. As our knowledge of the biology of repetitive behaviours grew, so greater emphasis was given to the psychological impact of the environment on animals exhibiting these behaviours and treatments were recommended which focused on environmental enrichment, which while more considerate, still have the potential to increase frustration if not used appropriately. Appropriate use requires a fuller understanding of both the problem, the individual and the methods of application available. As our approach becomes more informed by growing scientific knowledge we now have the potential to differentiate a variety of forms of repetitive behaviour. It is becoming increasingly apparent that cribbing is typically associated with fundamental changes in neurophysiology and so is unlikely to be effectively treated by simple management changes alone; however this is not the case in weaving, which seems to relate to a more acute frustration of locomotory behaviour. In short, typically, cribbing appears to meet the requirements of a psychological stereotypy, while weaving does not, although this may not always be the case. The development of simple non-invasive scientific techniques to assess underlying neurophysiology, such as eye-blink rates, gives us the potential to probe these differences and individualise treatments so we can give full consideration to the interests of the horse when we evaluate the management of these problems.

Similarly, developments in the science of animal training, communication and ethology allow us to take a more critical look at training methods, both new and old, as well as their application in practice. Only by understanding the principles can we have a meaningful debate about what is preferable in the interests of the horse, assuming a given method is applied optimally or at least in accordance with its intended action. We must avoid simple generalisations, e.g. that natural is necessarily better, that punishment is necessarily a bad thing or that things necessarily have to be done a specific way, but rather we must evaluate the programme as applied in light of the interests of all concerned and individualise our methods for the horse who is the focus of any training.

As equitation and equine science grows, we can look forward to not only more considerate and ethical management of the horse, but the ability to develop a truly symbiotic relationship in our interactions with horses. At the very least, we owe them the benefits of our learning if want to claim that we care about them, rather than simply care for them.

Stimulating innovation in sport and bringing knowledge and applied sport closer together

George de Jong
CEO InnoSportNL, the Netherlands

In the world of top sport the margins between success and 'also run' are becoming increasingly narrow. In the full knowledge that the slightest improvement to their performance may provide them with the ultimate edge, top athletes continuously hone all aspects of nutrition, materials, physical fitness, technique and mental skills. In the past few decades we have seen huge advancements in performance in almost all sporting disciplines. The question that it is being raised now is *when* rather than *if* such progress is coming to a halt. Nevertheless, the process of innovation as a driving force of development has much to offer to the domain of sport. Any innovation in sport must necessarily be seen as a joint initiative between knowledge institutes, the business world and the sport sector itself.

The Netherlands are an excellent example of a small country thinking big in terms of sporting ambitions. The goals outlined in the Olympic plan of 2028 can and will be realized through the mobilization and cooperation within the 'golden triangle' of science, business and applied sport. Practical questions arising from the daily training and competition routines are already being put forward to leading research institutes, while companies in and around the sector provide the commercial know-how to ensure research results are being translated into tangible products.

These types of projects can also offer tremendous opportunity for equestrian sports. For instance, the need to be able to monitor, and, if necessary, adapt different movements in aesthetic sports such as gymnastics, trampolining and rhythmic gymnastics has led to the development of an innovative camera system which allows athletes to record, review and assess their performances from every angle. Such a system could substantially benefit individual horse-rider combinations in the 'aesthetic' equestrian disciplines of dressage, vaulting and western. Another project aimed to improve the efficacy of after-cooling in preparation for the 2008 Beijing Olympics. The resultant cooling apparatus was able to cool without ice, and in accordance with individual specifications. Similar technology might also be used to optimize cooling procedures for endurance or eventing horses, helping to safeguard the health and welfare of the equine athlete. Additional projects, such as monitoring biofeedback processes in athletes in order to optimize their ability to cope under pressure, could be applied directly to equestrian riders, helping them to perform at their optimum when it matters most.

There can be no doubt that those involved in top sports are likely to make even greater and more stringent demands in future regarding support and facilities. Athletes and supporting personnel are often conservative and not used to/ not experienced in looking beyond their own circle. It is the responsibility of research institutes and businesses to assist sporting disciplines, such as equestrianism, in pushing boundaries, thinking creatively and being open to innovative research.

Since 2007 InnoSportNL has been playing a much more stimulating and facilitating role in this process. Growth figures from the past few years demonstrate an increase in the number of applied research projects with real implications to the sporting sector. An increasing number of companies and organisations are starting to see the value of joining forces with scientific institutes for the good of the sport. It is in that spirit that InnoSportNL has commissioned a report entitled 'Olympic gold, economic gold'. It outlines an innovation system for Dutch sports, which offers opportunities for the applied sector, business and academic institutions alike. There can be no doubt that the inroads that are being made now in devising innovative strategies to improve sporting performance will pay their dividends in years to come, benefitting all areas of sport.

Horse-rider interaction via the reins

Hilary M. Clayton, BVMS, PhD, DACVSMR, MRCVS
College of Veterinary Medicine, Mary Anne McPhail Equine Performance Center, Michigan State University, USA

Bits have been used to communicate with horses for at least 5,500 years. Many bits are available that differ in the type of mouthpiece and the leverage offered by the reins. Since the bit contacts sensitive structures within the horse's oral cavity, it is important to select, fit and use the bit correctly.

Horses vary in the size and shape of their oral cavities, which affects the type and size of mouthpiece that can be accommodated comfortably. Factors to consider include the position of the corner of the lips relative to the bars, the distance between the corners of the lips, the shape of the palate (flat or arched), and the size of the tongue. Measurements have shown no relationship between the horse's height and the dimensions of the oral cavity. Direct contact between the bit and the hard palate should be avoided.

A radiographic study compared the position of four bit types (loose ring, single-jointed snaffle; Baucher; KK Ultra; Myler comfort snaffle) and measured their proximity to the horse's hard palate and premolar teeth with and without rein tension. The mouthpiece of the single-jointed snaffle bit hangs down towards the incisor teeth and the sharply curved profile of the joint in the middle of the mouthpiece protrudes toward the hard palate. When tension is applied to the reins, the mouthpiece becomes more deeply embedded in the tongue, moving the joint away from the palate. The Baucher also has a single joint, but the mechanics differ from the loose ring snaffle because the cheekpiece attaches to a small upper ring that does not allow the mouthpiece to rotate around it. Consequently, the mouthpiece is fixed in a more elevated position on the horse's tongue with the joint adjacent to the palate and the mouthpiece has relatively little mobility. The loose rings of the KK Ultra allow the mouthpiece to rotate downwards and, in this position, the smooth surface of the central link is located further away from the palate than the single-jointed bits. Rein tension moves the entire mouthpiece of the KK Ultra away from the palate by compressing the tongue, and the central link rolls upwards over the surface of the tongue as rein tension increases. The relatively large separation between the central link of this bit and the palate, combined with the smoothness of the surface of the link, may explain why many horses perform well in this bit. The Myler comfort snaffle has a central barrel that allows a swiveling motion, without any nutcracker action. The mouthpiece lies quite high on the horse's tongue and sinks into the tongue, indicating relaxation of the tongue muscles. The position and angle do not change when tension is applied to the reins but the bit moves away from the palate by further indenting the tongue. Some horses perform well in a Myler bit perhaps due to the smoothness of the surface of the barrel, the higher position of the mouthpiece on the tongue, or the fact that the rigid mouthpiece allows the horse to push against it with his tongue to control pressure on the bars.

Video fluoroscopy was used to study the horses' response to different bits and the effects of rein tension. A variety of oral behaviours were seen including mouthing/chewing, retracting the tongue and sometimes bulging the dorsum of the tongue forward over the mouthpiece, and using the tongue to lift the mouthpiece. Each horse had preferred behaviours that were performed regardless of which bit was used. Behaviours were not associated with specific bits.

In order to determine whether horses can swallow when exercising with a bit, group of treadmill experienced horses cantered on a treadmill with a head collar, a cross-under bitless bridle, a single-jointed snaffle and a Myler bit. Side reins were used to flex the poll and a flexible endoscope was inserted through the left nostril into the nasopharynx to observe swallowing. The results confirmed that all horses were able to swallow with a bit in place while cantering with the poll flexed.

Strain gauge transducers have been used to measure rein tension dynamically when horses are exercised in hand or under saddle. The sensors are calibrated prior to each use and are located between the bit and the rein. The power source and transmitter fit into a small pack carried on the noseband or on a neck strap. When horses trot in hand wearing side reins, rein tension increases during each diagonal stance phase as the head and neck nod downwards under the influence of gravity and inertia. When the side reins are made of inelastic material, the minimal, mean and maximal tensions increase as the reins are shortened due to the restriction of head and neck movements. Compared with inelastic side reins, elastic side reins are associated with higher minimal tension and lower maximal tension but mean tension does not change. Therefore, mean tension is not a good variable to distinguish between the effects of different types of reins.

In horses ridden at sitting trot, rein tension increases and decreases twice in each stride, which is similar to the pattern seen with side reins. The minimal and maximal values with a rider are similar to those recorded for neutral or short inelastic side reins but the tension tends to rise more slowly with the rider. There are some differences between riders with regard to whether both reins show equal increases in tension or an alternating pattern that changes between left and right hands on the left and right diagonal stance phases. At canter, there is a regular rein tension pattern with a large peak in rein tension that occurs in the diagonal leading hind-trailing fore stance phase. This large peak is flanked by two smaller peaks coinciding with the trailing hind and leading fore stance phases.

Acknowledgement: Dr. Jane Manfredi collaborated on much of this research when she worked in the McPhail Center through the Merck-Merial Veterinary Scholars Program.

Facts, figures & fiction about flexion

P. René van Weeren, DVM PhD Dipl ECVS
Department of Equine Sciences, Faculty of veterinary Medicine, Utrecht University, the Netherlands

Head and neck carriage and the presumed health and welfare consequences thereof has been an extensively discussed topic in recent years in dressage. Surprisingly this has not been the case in show jumping, notwithstanding the facts that non-physiological head-neck positions are at least as often seen in that discipline and that the often-criticised low, deep and round carriage ('hyperflexion', 'Rollkur') in modern dressage was copied from practices in jumping. The differences in appreciation of a certain riding technique between disciplines suggests there are subjective rather than objective criteria at the basis of such appreciation, which stresses the need for objective measurements that serve as scientific grounds to break the impasse between opposing non-scientific opinions.

The first requirement that should be met if objective scientific research is to be conducted on any condition is the establishment of a clear and unambiguous definition of that condition. This requirement is not met in the discussion with respect to the head-neck position indicated by 'hyperflexion'. The position as depicted on the front page of Dr. Heuschmann's book 'Tug of war' (2007) is absolutely not the same as in the article 'Zur Brust genommen' that discussed the training methods used by the Dutch dressage trainer Sjef Janssen, published by 'Reiter Revue' in 2003. Fortunately, in the paper by Gómez Alvarez *et al.* (2006) on the effects of head-neck position on back movement a classification system was proposed that has been followed in later publications (Wijnberg *et al.* 2010, Kienapfel and Preuschoft 2011). Still, this is a source of confusion and it is the greatest importance to be clear about which position is meant.

An assessment of any training method that is meant to improve the performance of the complex entity of horse and rider is intrinsically complex and any person who deals with this matter only in simple terms of 'good' or 'bad' gives evidence that he or she lacks the competence and/or insight to discuss the item. When evaluating training methods in equestrian disciplines, both physical and mental factors play a role. Some of these can be measured relatively easily, others are very hard to quantify. Further, any outcome should be seen against the background of current ethical standards. These standards are not absolute, but are different in different cultural conditions, and change over time.

In the case of 'hyperflexion', possible physical effects that should be evaluated include effects on biomechanics of the horse (and hence possible influences on injury risk), effects on the respiratory system and possible local circulatory responses. Behavioural studies are the best tool to assess mental effects and to get an idea of the horse's perception, as far as that is possible. Some more quantitative tools to evaluate mental effects and associated stress levels include measurements of cortisol and heart rate and/or heart rate variability.

Thus far, most scientific work has been done on biomechanics. Gómez Álvarez *et al.* (2006) showed that, in the unridden horse, the 'hyperflexed' position resulted in an increased rage of motion of flexion-extension of the thoracolumbar spine and concluded that this result lent some credibility to the statements of some trainers that this position aided in the gymnastication of the horse, needed for dressage. Rhodin *et al.* (2009) could not confirm this in the ridden horse, but in that study a large part of the back could not be measured as it was hidden by the saddle. In both studies, other head-neck positions that were different to the natural carriage of the head in the horse, which included the elevated position asked for at competition, were investigated as well. These were also found to have significant biomechanical effects. In an *ex vivo* study on the effect of neck flexion or extension on the width of the foramina through which the cervical nerves emerge form the cervical vertebral canal (and hence on the possibility of nerve compression), it was shown that generally speaking flexion widened these openings and extension had a narrowing influence (Sleutjens *et al.* 2010).

Little has been done on the effect of head-neck position on the respiratory tract, but in a recent publication it was shown that all head and neck carriages that are not the natural one increase airway resistance (Sleutjens *et al.* 2011). This was certainly also true for the 'hyperflexed' position, but no negative effect on blood oxygenation (as suggested by many) of this position could be shown. On the contrary, a positive effect on oxygenation could be demonstrated.

Some work on behavioural effects of a hyperflexed position and on stress levels such a position might provoke has been done. A few studies report no adverse effects (Sloet van Oldruitenborgh *et al.* 2006, Van Breda *et al.* 2006), others report the opposite (Von Borstel *et al.* 2009, Kienapfel 2011). However, all these studies suffer from severe flaws (such as low numbers, no acclimatisation period, subjective observations) and the outcome should thus be considered with caution.

There is much fiction about (hyper)flexion, but few hard figures and facts. Thus far, it has not been shown that this position causes physical damage. Reports on potential negative effects on welfare are contradicting and the underlying research is not free from flaws, to say the least. The issue is too complex and too much determined by modulating factors such as training status of the horse, duration of time during which the position is maintained, etc. that unconditional condemnation or approval can ever be given on scientific grounds. For the time being, the approach taken by the FEI after the 2010 Round Table Conference on the issue, in which not the position itself but the way in which it is achieved is judged, seems most viable.

The full references can be asked to Prof. van Weeren.

Review of the forensic aspects of equine abnormal behaviour and vices

Sloet Van Oldruitenborgh-Oosterbaan, M.M.[1] and Blok, H.[2], [1]Department of Equine Sciences, Faculty of Veterinary Medicine, Utrecht University, Yalelaan 114, 3584 CM Utrecht, Netherlands, [2]Bouwman & Van Dommelen Attorneys, Biltstraat 182, 3572 BR Utrecht, Netherlands; m.sloet@uu.nl

Equine abnormal behaviour and vices are often the subject of debate and acrimony in vendor-relationships as most of these problems may not be detected during a veterinary prepurchase examination. Vices can be divided arbitrarily in aggressive vices (e.g. biting, charging, crowding, fighting, kicking, rearing and striking), vices arising from fear (e.g. avoiding and evading behaviour, halter pulling), a variety of performance-related vices (e.g. barn sour, running, head tossing) and stable vices (e.g. cribbing, wind sucking, pawing, self mutilation, stall walking, weaving, stall kicking). There are many suggestions as to the cause of vices, but there is very little scientific information on any of them. Most vices are thought to be a result of stress or boredom arising from unnatural environments. However, there may be underlying physical problems. Vices seem to appear spontaneously at almost any time in a horse's life, and although some observers have suggested that the vices can sometimes be copied from other horses, this is not proven at all. Heredity may also play a role. All published material relating to vices over the last 20 years was reviewed to objectively quantify the problem in the Dutch legal system. The results show that many of these cases end up in a legal conflict. There is a lack of uniformity in the declarations of expert witnesses and the consequent legal decisions vary enormously. In conclusion, a review showed that further basic research is urgently needed to objectively judge equine abnormal behaviour patterns and vices.

Equine abnormal behaviour and vices are a common source of problems and disputes that result in legal procedures. A better understanding of these behavioural problems by vendors, purchasers, veterinarians, attorneys and judges would probably limit misunderstandings and protracted (expensive) litigation.

Stress response of three-year-old mares to changes in husbandry system associated with equestrian training

Fischer, R.[1], Wulf, M.[2], Becker-Birck, M.[2], Aurich, J.[1], Rose-Meierhöfer, S.[3], Hoffmann, G.[3], Möstl, E.[1] and Aurich, C.[2], [1]University of Veterinary Sciences, Veterinärplatz 1, 1210 Vienna, Austria, [2]Graf Lehndorff Institute for Equine Science, Hauptgestüt 10, 16845 Neustadt (Dosse), Germany, [3]Leibniz Institute for Agricultural Engineering, Bornim, 14468 Potsdam, Germany; regina.fischer@vetmeduni.ac.at

Based on physiological parameters, it has been shown that initial training and first mounting of a rider are major challenges for young horses. For initial training, horses are often transferred from group housing to individual boxes and separation from the herd is an additional stressor. We have determined salivary cortisol concentration, locomotion (ALT pedometers), heart rate (HR) and HR variability (SDRR: standard deviation of beat-to-beat interval) in 3-year-old mares (n=8). Mares were transferred from a group stable with access to a paddock into individual boxes without paddock and were studied from 5 d before to 5 d after changing the stable. Mares in individual boxes underwent a standard training for young horses. We hypothesized that the change in husbandry system leads to increased cortisol release, changes in HR and SDRR and reduced locomotion. Before mares were moved to individual boxes, cortisol concentration showed a diurnal rhythm with values around 0.6 ng/ml in the morning and a decrease throughout the day. When horses were moved to individual boxes, cortisol concentration increased to 1.8±0.2 ng/ml and did not return to baseline values within 6 h ($P<0.05$ over time). On the next days, a diurnal rhythm was re-established but at a higher level than before. Locomotion activity was highest after transfer of mares to individual boxes (83±10 min/5 h) but was only slightly higher than during the time mares spent with the group in a paddock (60-70 min/5 h). On days 2-5 in individual boxes, locomotion was reduced compared to the group stable. HR increased and SDRR decreased when mares were separated. In conclusion, separating horses during initial training from their group is an additional stressor, although the stress is less pronounced than induced by other challenges, e.g. transport. After an initial period of increased locomotion, mares moved less in individual boxes than when kept in a group. Group housing is thus associated with mares exercising themselves, such an effect is reduced when they are kept individually.

Keeping horses in a group is associated with less stress and with horses exercising themselves to a certain extent during times when they are not ridden. Supported by the Austrian Federal Ministry of Agriculture, Forestry, Environment and Water Management.

Life experience and object-directed emotions in horses

Baragli, P.[1], Vitale, V.[1], Banti, L.[1], Bergero, D.[2] and Sighieri, C.[1], [1]University of Pisa, Department of Physiological Sciences, viale delle Piagge 2, 56124 Pisa, Italy, [2]University of Torino, Department of Animal Production, Epidemiology and Ecology, via Leonardo da Vinci 44, 10095 Grugliasco (TO), Italy; pbaragli@vet.unipi.it

In humans, the expression of emotions varies with age, while there are no data on the subject regarding horses. The aim of this study was to evaluate the expression of emotions in two groups of geldings of different ages: Young adults (27 horses, aged 4-9 years) and Old adults (25 horses, aged 19-24 years). All were school horses from six riding centers (Piemonte, Italy) and were selected based on the compilation of an individual checklist (several inclusion criteria were followed and horses with stereotypes were excluded). The horses underwent a novel object test (an inflatable balloon that suddenly appeared in the familiar stall) for a period of 5 min with the hypothesis of inducing negative emotions according to the 'a priori' design of a stress test. During the test the heart rate (HR), its time domain variability (RR, RMSSD, SDRR) and behavioral parameters (latency of onset, frequency and percentage duration of attention, exploration and avoidance manifested by horse regarding the balloon) were monitored. The heart rate variability has been recorded by RS800® (Polar, Kempele, Finland), while behavior was detected by a webcam placed close to the inflated balloon. For the analysis we first used the Kolmogorov-Smirnov test, than the Mann-Whitney test (behavioral data) and one-way ANOVA (heart rate variability) were used. Old horses showed a significant decrease in the percentage of attention (z=2.44, P=0.015) and increased latency of exploration (z=3.21, P=0.001). In the same group frequency (z=3.38, P=0.000) and percentage of exploration (z=4.18, P=0.000) decreased, as did the frequency of avoidance (z=2.85, P=0.004). Again, in the Old group SDRR (F=16.01, P=0.000) and RMSSD (F=9.09, P=0.005) decreased, while no differences were found for HR (F=1.02, P=0.319) and RR (F=1.17, P=0.287). Young adult horses showed a higher frequency of avoidance and increased exploration activities with respect to the balloon, while the older subjects were less responsive to behavioral stimulation and a shift toward sympathetic control was highlighted. Therefore, aging and experience could influence emotional response to negative stimuli in horses.

From behavioral data, old horses seemed to be calmer and more used to novelty, suddenness and unfamiliar stimuli. However, evaluation of their heart rate activity showed that they were more stressed that younger adult horses. Thus, offering the simplest explanation for equine behavior could induce error and older horses may have a different way to show their negative emotional state.

Evidence for differences due to gender in manageability of yearling horses

Wulf, M., May, A.-C. and Aurich, C., Graf Lehndorff Institute for Equine Science, Hauptgestüt 10, 16845 Neustadt (Dosse), Germany; manuela.wulf@neustaedter-gestuete.brandenburg.de

Due to changes in the use of horses from working animals to recreational companions, the demand for easily manageable horses is increasing. In adult horses, pronounced gender differences exist and many riders prefer male horses to mares. This is due to the fact that mare-characteristic behavior may interfere with handling, training and performance. In the present study we tested the hypothesis that gender differences in the manageability of horses are at least in part caused by inherited gender-dependent behavioral patterns. A total of 15 warmblood yearling horses (6 male and 9 female) were used. They were kept under identical conditions in groups separated by gender and had regular contact to humans during feeding times. On experimental day 1, the horses were exposed to a stationary test and an approach test while on days 2 to 5 they were exposed to an approach test and a tolerance test with an unknown person. The person entered the test area 60 sec after the horse was released. After 5 min (day 1) or 60 sec (day 2-5), the person approached the horse to halter it. Cardiac beat-to-beat-interval (RR) was determined (S810i, Polar, Kempele, Finland) from one hour before to 2 hours after the test. The time until completion of haltering was measured and the horses´ response to different handling approaches was determined. Statistical differences were evaluated with the General Linear Model analysis (Fisher test) of the SPSS statistics package. Exploration behavior of horses was neither affected by gender nor by day. Time for haltering and score for easiness to halter the animal was significantly affected by day ($P<0.05$) and a significant interaction of day and gender was detected ($P<0.05$; e.g. time for haltering: fillies day 1: 23.8±7.8 s (± SEM), day 5: 21.1±1.7 s; colts day 1: 53.6±10.4 s, day 5: 19.4±2.2 s). The RR interval during the test and 10 min after the end of the test was significantly affected by day ($P<0.01$) but not by gender (e.g. mean RR interval during test: fillies day 1: 1,051±103 msec; day 5: 1,372±103 msec, colts day 1: 985±94 msec, day 5: 1,262±94 msec). Results show a fast adaption of yearling horses to unknown humans and handling procedures. The hypothesis of gender differences in the manageability of prepubertal horses is supported.

Sex differences in behavior do not only exist between adult mares and stallions but are already present in young horses before puberty. When exposed to unknown humans for the first time, colts may behave more guarded than fillies.

Social learning in horses: does the demonstration of a conspecific affect the ability to solve a detour task?

Dalla Costa, E., Allegrini, M., Cerri, E. and Minero, M., Universita degli Studi di Milano, Dipartimento di Scienze Animali, via Celoria, 10, 20133 Milano, Italy; manu.dallacosta@gmail.com

It has been difficult to find an effect of social learning in horses, perhaps more attention should be given to factors shown to affect it in other species, such as social dominance, group stability and experimental design. The aim of the present study was to investigate social learning by considering the effects of observing a trained dominant horse demonstrating a detour task. Seventeen horses (5 geldings and 12 females) of different breeds and ages took part in this study, all have been kept permanently on pasture in the same social group for the last 3 years. The dominance hierarchy order was defined through observation of dyadic interactions (focal animal sampling method): agonistic and submissive behaviours were ranked in a squared matrix. The highest rank horse was trained for detouring a U shaped fence to reach a bin with food. Horses were assigned to Control or Demonstrator Group using a randomization process stratified for gender, age and social rank. Single horses underwent to 10 detour trials divided in 3 sessions. Prior to testing, horses from Demonstrator Group were allowed to watch a conspecific detouring. We analysed the ability to solve the task and the latency to complete the detour. Mann-Whitney test was used to verify differences between groups. We found that demonstration did not improve the ability of the horses in solving the task: 4 subjects of the Control Group versus only 2 subjects of the Demonstrator Group reached the goal. The mean time to complete the detour was 58s (SD=23) for the control group and 49s (SD=31) for the Demonstrator Group (NS). Our results clearly did not prove social learning in horses, however some important considerations can be derived about factors affecting similar studies. Although living in a stable social group is important in social learning tests, horses managed in groups may be, as in our case, more motivated by social companionship than by food rewards. A spatial task is more likely to be transmitted than an operant task with less obvious proximate advantages to the performer but, as horses have short-term spatial recall of less than 10 s, the time between the demonstration and the trial could have been too long. Further studies should consider social reinforcements and better timing. It would be also interesting to assess the effect of the demonstration of a leader instead of the dominant one.

This study failed to provide evidence of social learning in horses. The possibility of applying social learning techniques in horses would make training gentler to the horse, quicker and more effective.

Problem solving in the horse (*Equus caballus*) using a detour task

Savin, H. and Randle, H., Duchy College, Equitation Science, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom; hayley.randle@duchy.ac.uk

Problem solving in tbe horse (*Equus caballus*) using a detour task Hannah Savin and Hayley Randle Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, UK The importance of understanding equine cognitive abilities has become widely recognised, not least because they can be used as an indicator for welfare. Detour tasks are often used to assess spatial problem solving abilities and in horse studies have focussed on the attaining of a goal, often based on the horses well developed spatial awareness. The aim of this study was to investigate detour abilities in horses and to determine the extent of the effort made to obtain a goal that had been obstructed. 4 horses (of various ages, breeds and sexes) were required to reach a goal, a piece of carrot placed in a food bucket located behind a 1 m x 1 m x 12 mm plywood barrier. Horses were positioned 3 metres from the goal. Each horse was released immediately after observing the carrot being placed in the bucket. The time (s) taken from release to reach the goal was recorded where the subject was considered to have attained the goal once it touched the carrot. A maximum time of 180 s was allowed to achieve the goal. Successful trials were followed by expansion of the barrier until a maximum length of 5 m was reached. If a horse failed to complete a trial successfully within 180 seconds the trial was terminated. Preliminary results show that the average time to reach the 3 m goal was 61s (61.0±.80.5), 4 m was 74s (74.0±45.5) and 5 m 49s (49.0±13.2). Results also showed there was no significant difference of detour tasks difficulty on solving time ($F_{2,7}$=0.11; P>0.05) and there was no significant effect of subject on solving times ($F_{3,9}$=266; P>0.05). The method used in this detour-study allows the examination of the complex cognitive abilities of horses. Specific tasks such as the detour ability assessment used in this task together with the correct application of learning theory has the potential to advance equine welfare as equine behavioural science knowledge expands.

This pilot study has demonstrated that horses possess the abilities required to solve problems, in particular those that involve negotiating obstacles in order to achieve a preferred item (in this case a food treat). This assessment has been used to assess spatial awareness, rate of learning and lateralisation preference in many species. Humans associated with horses and ponies should take such cognitive abilities into account when interacting with the individuals in their care.

Lack of effect of a tryptophan product on behavioural and physiological parameters of competition horses during a stressful event

Liss, S. and Wolframm, I.A., University of Applied Sciences Van Hall Larenstein, Postbus 411, 6700AK Wageningen, Netherlands; inga.wolframm@wur.nl

Competition horses are often subjected to stressful situations. Several supplements that claim to reduce equine stress levels are marketed worldwide, yet the effectiveness of these supplements remains ambiguous. The current study aimed to investigate the effect of an orally administered tryptophan product on horses´ reaction to an acute stressor. Sixteen mature warmblood riding horses (N=16, 3 gelding, 13 mares) were used in the study. Loading onto a two-horse trailer parked in an enclosed arena served as the acute stressor for the purpose of this study. Horses were used as their own controls in a blind cross-over design and were tested on two separate testing days, held two weeks apart. During the experimental condition each horse was fed one oral dose of tryptophan (2.0 mg kg-1) three days prior to and on the day of the experiment, according to the manufacturer´s recommendations and in addition to their usual rations. For the control condition horses were fed only their normal rations. Heart rate was recorded during rest for each horse before and after loading and during the process of loading for all horses (n=16). Saliva samples (n=10) were collected from ten horses 40-60 minutes prior to the test (sample A) and 10-20 minutes after the test (sample B) on both test days. Behaviour was recorded with an ethogram at rest for each horse (n=16) and throughout the process of loading. Most important results revealed that salivary cortisol concentrations of horses during the experimental condition did not differ from cortisol concentrations during the control condition ($t(9)=0.16$, $P>0.05$). Furthermore, heart rates of horses during the experimental condition did not differ from the heart rates during control conditions ($t(15)=-1.66$, $P>0.05$). Behavioural parameters of horses during the experimental condition did not differ significantly from their behaviour during the control condition (vocalization $t(15)=1.37$, $P>0.05$; defecation $t(15)=-0.9$, $P>0.05$; time spent chewing $t(15)=-0.9$, $P>0.05$)). Findings indicate that a dosage of 2.0 mg kg-1 a tryptophan-based product aimed at reducing stress-related symptoms in the horse does not seem to have the desired effect.

The current study seems to indicate that nutritional supplements aimed at relieving stress symptoms in the horse may not always be effective. In order to prevent horses to adversely react to stressful situations riders, trainers and handlers of horses should spend time building the horse's trust under different circumstances.

Sensorimotor gating in equine stereotypy: prepulse inhibition of the acoustic startle reflex

Van Der Laan, J.E. and Mills, D.S., University of Lincoln, Department of Biological Sciences, Riseholme Park, Riseholme, Lincoln, LN2 2LG, United Kingdom; janneke.vanderlaan@student.uva.nl

The neurological basis of stereotypic behaviour in horses is a source of some debate. Dopamine is frequently cited in relation to its potential involvement in stereotypic behaviour across species. It has been suggested that equine stereotypies are the result of increased dopaminergic activity ('sensitization') within the basal ganglia. This brain system is also involved in sensorimotor gating. A reliable diagnostic mechanism for measuring sensorimotor gating deficits is by quantifying prepulse inhibition (PPI) of the acoustic startle reflex. We aimed to develop a field test to allow us to examine whether horses that show stereotypic behaviour also exhibit dysfunctional PPI, which might reflect changes in sensorimotor gating due to enhanced dopamine transmission in the basal ganglia. Also, the aim was to distinguish between different types of stereotypies in order to find possible differences between the different stereotypies. Horses were tested for mild acoustic startle response and PPI. It was hypothesized that horses that show stereotypic behavior will show a reduced PPI of the acoustic startle response compared to control horses. 20 horses (control n=8, cribbers n=8, other stereotypies n=4) were tested in their own stable. The horse's behaviour was captured on camera in order to record the characteristics of a startle response. Data was analyzed using the non-parametric Wilcoxon sign test to compare between control horses and the different stereotypies. Both stimuli, startle (SP) and startle + prepulse (PSP), significantly increased the occurrence of startle elements in the behaviour of the horses ($P<0.05$), indicating that the pulses evoked a mild startle reaction. One of the startle characteristics (the instant eye blink) and the overall number of startle characteristics were significantly more likely in the SP compared to the PSP condition for control ($P<0.05$) but not stereotypy horses. This effect disappeared when the stereotypies were separated in different groups, probably due to the small sample sizes. However, the results suggest that horses that show stereotypic behaviour might have reduced PPI of the acoustic startle reflex compared to non-stereotypic horses. This is consistent with the suggestion that stereotypic behaviour in horses is associated with dopamine dysfunction in the basal ganglia.

The results of this study suggest that stereotypic horses show a neurological change associated with a change in reactivity. Thus, these behaviours should not be considered simply character faults or management problems, but require a more encompassing biological evaluation, in order to develop treatments which seek to address the underlying mechanism, rather than simple the signs.

Horses and abnormal behaviour: a questionnaire answered by trainers, riding schools and horse breeders in three counties in Sweden

Lundberg, A., Andersson, M., Eisersiö, M. and Sandberg, A., University of Agricultural Sciences, Dept of Animal Environment and Health, Box 234, SE-532 23 Skara, Sweden; anna.lundberg@slu.se

Behavioural problems such as crib-biting, weaving and box-walking have been shown to be significantly correlated with our horse management. Behavioural problems can be seen in horses of various breeds, ages and in all equestrian disciplines, however not among feral horses. They are considered to be negative for the horse's welfare. Reported frequencies of horses showing abnormal behaviour in different populations are between 1.4- 30.3%. Behavioural problems are often developed at the time of weaning and known preventive factors are social contact with other horses, free movement, a high roughage diet and good weaning practices. The aim of this study was to investigate how horse breeders, trainers and riding instructors in Sweden experience and think upon behavioural problems in horses. The study was carried out as a questionnaire during 2009 and 2010 and the respondents were contacted by e-mail, mail or phone. The response rate varied between 34% (breeders), 68% (trainers) and 70% (riding schools) and a total number of 10 684 horses was covered. 78% of the breeders had experienced abnormal behaviour among some of their foals. On riding schools 4.6% of the horses performed abnormal behaviour and the correspondent value among trainers was 4.0% of the horses. The most common stereotypi was crib-biting. The results showed that there exist some misconceptions concerning the inheritance and copying of abnormal behaviours and the knowledge about cause and the preventive factors are deficient. Only 14% of the breeders believed that weaning is a critical period that can cause abnormal behaviour. The advice proposed by trainers and riding schools to treat abnormal behaviour were often very general such as 'reduce stress' and 20% of the trainers and 21% of the riding schools did not mention any of the primary needs found in research such as increased social contact, roughage and exercise neither as cause or prevention. Ten percent of the respondents reported incorrect advices. Most believed that behavioural problems are harmful to the horse and will decrease the horse's value. A majority of the respondents find that the accessible information about behavioural problems is insufficient.

Abnormal behaviour concerns a majority of horse owners but even since a comprising research has been done in this area there is a lack of knowledge on how to prevent and treat behavioural problems with a risk that wrong interventions are taken and a reduced welfare of these horses. There is a need for more education and understanding on how these professional groups best acquire information.

Using horse behavior to enhance the welfare of wild horse gathers: observations of four designated observers

Heleski, C.R.[1], Greene, E.A.[2], Ralston, S.L.[3] and Stull, C.L.[4], [1]Michigan State University, East Lansing, MI, 48824, USA, [2]University of Vermont, Burlington, VT, USA, [3]Rutgers University, New Brunswick, NJ, USA, [4]University of California, Davis, CA, USA; heleski@msu.edu

The management of wild horses involves horse-human interaction. Utilizing features of horse behavior can enhance horse welfare during gathers. The Bureau of Land Management (BLM) has a priority to ensure that public rangelands in the western U.S. are sustainable for multiple stakeholders. BLM has traditionally managed equid populations by conducting periodic gathers to remove excess animals for range conditions. In 2010 the American Horse Protection Association developed the Independent Designated Observer Program, with 4 academica-based equine specialists charged with observing behavior and assessing welfare of 352 wild horses during 11 gather days. Knowledge of equine behavior was utilized in the location and design of trap facilities, training/utilization of a Prada horse, and handling/sorting horses once gathered. The gather sites were identified by wranglers and helicopter pilots where the horses naturally travelled. A funnel shaped fenceline guided horses into corrals. No corners were present in the corrals/passageways. Gate panels were wrapped with snowfence to give the appearance of solid walls while still allowing light and avoiding shadows. Once horses were located, a helicopter pilot utilized advance and retreat methods to keep horses moving forward, but not faster than a trot. An innovative behavioral tool utilized was the use of a Prada horse. This horse was let out past the mouth of the trap site in advance of the wild horses arriving. Once the Prada horse was within sight of the wild horses, he was released and galloped through the funnel trap into the corral. In all but two observed instances the wild horses followed the Prada horse into the trap. When sorting horses, lactating mares and their foals, young stallions, mature stallions, and non-lactating mares were grouped into separate pens. While members of the mature stallion group might be expected to engage in extensive agonistic behaviors, this was not observed. As the first few stallions were put into a pen, there would be some isolated agonistic behavior, but after 4-5 stallions were in the pen, agonistic encounters were virtually nonexistent. We hypothesize that the stallions reverted back to bachelor band behavior since mares were in a separate pen. Handlers sorted horses using handling aids constructed of a pole with a plastic bag attached to provide visual/auditory stimuli rather than relying on physical force. Full report available at http://tinyurl.com/3hzrcuv.

Overall, the knowledge of equine behavior by those involved was comprehensive and was utilized to reduce stress/potential injuries to the wild horses.

Investigating frequency and duration of nocturnal ingestive and sleep behaviours of horses bedded on straw versus shavings

Greening, L.M., Shenton, V., Wilcockson, K. and Swanson, J., UWE Hartpury, Department of Animal and Land Science, Hartpury College, Hartpury House, Gloucester, Gloucestershire, GL19 3BE, United Kingdom; linda.greening@hartpury.ac.uk

Horses are stabled overnight for a number of practical reasons however there is little research quantifying nocturnal equine behavioural patterns in different housing environments. The aim of this study was to establish whether differences in frequency and duration of sleep and ingestive behaviours were apparent for horses bedded on straw or shavings. Ten geldings of mixed breed (average age 7.3 years) bedded on either straw (group one) or shavings (group two) for more than five months previously, were observed between 1900 and 0700 hours. All horses were individually stabled on the same yard and underwent light to medium work but were privately owned and therefore subject to different routines. Each stable measured 12x12 ft and bedding included banks with minimum bed depth approximately 10 cm. Duration of behaviour was recorded in minutes using a video recorder. Only sleeping behaviours lasting more than one minute were recorded. Frequency of behaviour was recorded using continuous focal sampling. Data was analysed using an ethogram and Mann-Whitney U tests. Total average duration of sleep for group one (398 mins +46.38) was significantly different ($Z=-1.984$; $P<0.05$) compared with group two (342 mins +36.28). Group one on average engaged in longer periods of sternal and lateral recumbency (162 mins +93.14 and 49 mins +34.52 respectively) compared to group two (83 mins +36.28 and 5 mins +36.28 respectively). On average horses spent 54% of the observation period engaged in ingestive behaviour, which included ingestion of bedding. No significant differences were observed for frequency ($Z=-0.420$; $P>0.05$) or duration ($Z=-0.731$; $P>0.05$) of ingestive behaviours between group one and two. For both groups duration of bedding ingestion peaked between 0100 and 0700. In total group one spent on average more time ingesting bedding (70 mins) compared with group two (7 mins). Casual observations revealed horses were motivated to alternate between eating hay and bedding. The average duration of nocturnal ingestion is comparable with previous data conducted at the same time of year but studying feral horses. Results indicated bedding influenced duration of periods of drowsiness, sleep in lateral recumbency and paradoxical sleep.

Straw bedding appears to aid display of natural behaviours, encourage beneficial nocturnal sleep patterns, and satisfy biological motivation for variety within the diet more so than shavings.

Assessment of ridden horse behaviour

Hall, C.[1], Taylor, L.[1], White, C.[1], Owen, H.[1], Huws, N.[1] and Mcgreevy, P.[2], [1]Nottingham Trent University, School of Animal, Rural and Environmental Sciences, NG25 0QF, United Kingdom, [2]The University of Sydney, Faculty of Veterinary Science, NSW 2006, Australia; carol.hall@ntu.ac.uk

Assessments of the behaviour of ridden horses form the basis of performance evaluation. The purpose of this evaluation will determine the factors considered important and how poor performance is identified. Currently there is no consistent objective means of assessing ridden horse behaviour and inevitably, given the different equestrian disciplines, the likelihood of a universal standard of good and bad performance is remote. Nevertheless, in order to protect the welfare of the ridden horse we should strive for consensus on an objective means of identifying behavioural signs indicative of the 'Happy Equine Athlete' as introduced by the Fédération Equestre Internationale (FEI). Current technological developments enable objective evaluation of some aspects of ridden horse behaviour including rein tension, limb phasing, GPS and pressure mapping. Performance analysis often relies primarily on subjective judgement and questions persist about the contribution of such technologies. The development of a list of behaviours exhibited by ridden horses, a ridden horse ethogram, will facilitate recording of behavioural events for use as a consistent descriptive tool. However, without objective evidence of the relevance of this behaviour, such a tool has limited value. In addition, to ensure that the equestrian world sees merit in such a tool, current approaches to performance evaluation must be incorporated into any resultant guidelines. The aim of this review is to compare the performance criteria of different groups within the equine industry and to identify the behaviours they refer to. The current and potential contribution that objective measures can make in this process is reviewed and the potential for developing a universally accepted set of criteria that identify the 'Happy Equine Athlete' discussed. We believe that the only way to improve the welfare of the ridden horse is by objectively identifying behavioural signs that indicate that the horse is either comfortable or uncomfortable with the activity in which it is participating. With clear evidence to support this, appropriate adaptation of performance criteria in all disciplines can proceed along with alignment in training systems that ensures a mutually positive experience for both horse and human partners.

Different groups within the equine industry rely on different behavioural signs when evaluating the performance of the ridden horse but the behaviour that indicates whether the horse is in fact a 'Happy Athlete' should be common to all. This review explores whether behaviour and other measures can be used to assess this aspect of performance regardless of discipline.

Whipping of Australian Thoroughbred racehorses in the penultimate 200 metres of races is influenced by jockeys' experience

Mcgreevy, P.[1] and Ralston, L.[2], [1]University of Sydney, Faculty of Veterinary Science, University of Sydney, New South Wales, 2006, Australia, [2]Swinburne University of Technology, Institute for Social Research, PO Box 218, Hawthorn, Victoria, 3122, Australia; paul.mcgreevy@sydney.edu.au

Animal welfare issues associated with whip use during Thoroughbred races in Australia are of increasing importance as the racing industry seeks to promote the wellbeing of its equine athletes. Recent data have called into question the justification of whip use as either an accelerator or for steering. Our aim was to investigate associations between whip use and pre-race variables including jockey experience (apprentice versus non-apprentice), starting price, weight carried and barrier drawn. If the whip is genuinely used in response to a given horse's performance, there should be no consistent predictors of whip use. We explored the influence of these variables on official whip counts for the race section 400 to 200 m from the finish (S2), and the section 200 m to the finish (S1) over five 1,250 m and 1,220 m races involving apprentice (n=7) and non-apprentice jockeys (n=18) (in which 49 horses were eligible for this study) and found that, for S1 alone and when whip use in S1 and S2 was summed (i.e. to summarize the final 400 m of a race), there were no significant predictors on whipping. However, in S2, apprentice jockeys whipped horses on average more than three times more than non-apprentice jockeys (1.48 vs 0.45; P=0.022). Unexpectedly, horses drawn close to the rail were whipped more than those drawn further from the rail. These findings suggest that barrrier draw and rider inexperience in Thoroughbred racing influence the distribution of whippings imposed on horses as they tire in the penultimate 200 m section and may contribute to the growing debate surrounding whip use in the sport of horseracing. This preliminary report involved only small numbers of horses and jockeys and so should be viewed as a trigger for larger scale investigation of the pre-race predictors of whip use in Thoroughbred racing.

If the whip is genuinely used in response to a given racehorse's performance, there should be no consistent pre-race predictors of whip use. However, this study shows that, in the small number of random races studied, jockeys' experience had a strong influence on their use of the whip. This suggests that whipping is a crude intervention.

Do dressage and show jumping riders in Sweden differ in perception of optimal horse temperament?

Axel-Nilsson, M.[1], Nyman, S.[2], Visser, K.[3] and Blokhuis, H.J.[1], [1]Swedish University of Agricultural Sciences, Department of Animal Environment and Health, Box 7068, 750 07, Sweden, [2]Flyinge AB, Flyinge Kungsgård, 247 93 Flyinge, Sweden, [3]Wageningen UR, Livestock Research, Postbus 65, 8200 AB Lelystad, Netherlands; malin.axel-nilsson@slu.se

The match between horse and rider influences performance as well as welfare of both parties. Several interacting characteristics of horse and rider have an impact on the match: level of education, physical condition, the rider's aims and both their personalities and temperament. The aim of the present study was to list temperamental characteristics that riders consider relevant for a good match between horse and rider, and to analyze possible differences between riding disciplines. A web based questionnaire was used in which the respondents voluntarily chose to participate. The target group included Swedish riders on all levels of experience and within different disciplines. The questionnaire was advertised in popular scientific journals, horse magazines, daily press, TV, radio and through social networks. The questions on temperamental characteristics were based on the Big Five theory, which is commonly used in human psychology and describes personality in five dimensions: openness to experience, conscientiousness, extraversion, agreeableness and neuroticism. Fourteen characteristics that cover these dimensions and were considered to occur in horses were defined. The total number of respondents that indicated their main discipline was 2752, of which 815 and 459 respectively stated dressage or show jumping. In five of the fourteen temperamental characteristics there was a significant difference between dressage and show jumping riders in perception of relevance (yes/no) for a good match (χ^2-test, $P \leq 0.05$). These were: hot (P=0.0009), fearful (P=0. 0016), alert and forward (P=0.0069), dependent on company of other horses (P=0.0081) and temperamentful (P=0.0211). The two groups also differed in their grading, indicated in the questionnaire on a scale from one to five, of the relevant temperamental characteristics. Differences between the two groups of riders were tested with a Mann-Whitney U test ($P \leq 0.05$). Based upon a deeper knowledge and understanding of the temperamental characteristics of horses and riders and their impact on the match, we aim to develop a tool for temperamental assessment of horses that can facilitate a good match between horse and rider.

A good match between horse and rider and/or the type of work the horse is required to do is of great importance. We aim to define which temperamental characteristics of horses are relevant for a good match and develop a test to measure those. Such a test can then be used to select horses for a specific rider or for a certain type of work.

Comparison of heart rate response to natural and conventional training methods in Purebred Arabian colts and fillies

Kędzierski, W.[1], Janczarek, I.[2] and Stachurska, A.[2], [1]University of Life Sciences in Lublin, Department of Animal Biochemistry and Physiology, Akademicka 12, 20-033 Lublin, Poland, [2]University of Life Sciences in Lublin, Department of Horse Breeding and Use, Akademicka 13, 20-950 Lublin, Poland; witold.kedzierski@up.lublin.pl

Horse emotional status is important not only in the view of animal welfare, but also considering training efficiency. The horse emotional response to various methods of training is not enough documented. The aim of the study has been to explore the hypothesis that the emotional response of naïve Purebred Arabian colts and fillies to initial training is lower in the case of natural methods (NT) compared to conventional training methods (CT). 32 Purebred Arabian horses (2.5 years ± 3 months of age) were subjected to initial training in a national stud in Poland. 16 horses were trained by NT and another 16 horses using CT. Both groups comprised equal number of colts and fillies. The horses trained using CT were firstly walked on the automated walker and then lunged inside a manège. When the caretaker was able to control the horse to trot on the lunge, the horse was saddled and lunged under saddle. After accepting the saddle, the horse was mounted by a rider. The NT was based on the system of freestyle training method applied in Europe. The horse was trained inside the round-pen. Natural trainers used the following techniques: groundwork, schooling to avoid pressure, and applying habituation to frightening objects. When the horse accepted saddling and leaning over the bareback, the trainer was moving into a sitting position. To assess the horse emotional response to training process, the heart rate (HR) was measured telemetrically. One minute intervals were analysed at rest, at first saddling and tightening the girth (S), during first walking under the saddle (W) and during human mounting the naïve horse (M). The HR measured at S and M was significantly higher when CT was used compared to NT. In NT group, the HR scores registered at M were significantly higher in colts than in fillies (161±11.2 vs. 122±9.20, $P<0.01$). On the contrary, in CT group, the HR scores measured at S and W were significantly higher in fillies compared to colts (90.6±29.7 and 108±38.5 vs. 55.0±10.1, $P<0.05$ and 74.8±30.4, $P<0.05$, respectively). The initial training of naïve Purebred Arabian horses with the use of NT involved less emotional response than CT. In NT group, colts were less excited than fillies.

In the study, the emotional arousal in initial training of naïve Purebred Arabian horses was measured with heart rate. The advantage of natural training method compared to conventional method was proved. The natural method caused a lesser emotional response in the horses. Particularly colts positively reacted to the natural method.

The development of a mental skills inventory for equestrian riders

Wolframm, I.A. and Beck, J., University of Applied Sciences Van Hall Larenstein, Postbus 411, 6700AK Wageningen, Netherlands; inga.wolframm@wur.nl

Substantial evidence suggests that the use of mental skills can help to improve competitive performance across different sporting disciplines. However, little research exists investigating the use of psychological skills in equestrian sports and to what extent riders refer to their horses when mentally preparing for a competition. The aim of the current study was to develop a German language psychometric inventory measuring mental skills in equestrian sports (MSI-E). A preliminary version of the MSI-E was developed focusing on the mental skills of dealing with difficult situations, goal setting, arousal control, concentration, self-talk and imagery. The preliminary inventory contained 44 items rated on a 4-point Likert scale and was completed by 297 German riders (male N=28, female N=269; dressage N=115, showjumping N=113, eventing N=48, leisure N=13, western N=6, vaulting N=2). Prior to statistical analysis all negatively worded items were reversed to ensure appropriate scoring. The Kaiser-Meyer-Olkin Measure of Sampling Adequacy was 0.79 and the Bartlett's Test of Sphericity reached significance ($P<0.0001$), ensuring that the data were suitable for factor analysis. Following Principal Component Analysis, six factors were retained explaining 43.44% of variance. Four of these factors showed good internal consistency with Cronbach's Alpha values between 0.70 and 0.83. Factors five and six showed mediocre to poor internal consistencies with Cronbach's Alpha of 0.53 and 0.24 respectively. Factors one through to five were retained for the next stage of data collection. This revised version of the MSI-E contained 38 items and was administered during the second phase of data collection to an additional 371 riders (mean age 27.2±9.44; male N =32, female N=339; dressage N=179, showjumping N=128, eventing N=38, leisure N=17, western N=8, vaulting N=1). Factors were once again examined for internal consistency with four factors achieving good internal consistency with Cronbach's Alpha values between 0.88 and 0.67. The resulting version of the MSI-E consequently contains the following four factors: Factor 1= 'dealing with difficult situations', Factor 2= 'goal setting', Factor 3='arousal control' and Factor 4='imagery'.

The MSI-E is a sport psychological inventory that can help riders assess their own use of mental skills prior to competing. Unlike other sport psychological questionnaires, the MSI-E also takes into account to what extent riders refer to their horses during competition preparation.

How do riders choose their horse's tack and riding equipment?

Hockenhull, J.[1] and Creighton, E.[2], [1]University of Bristol, School of Veterinary Sciences, Langford, Bristol BS40 5DU, United Kingdom, [2]Newcastle University, School of Agriculture, Food and Rural Development, Newcastle-upon-Tyne, NE1 7RU, United Kingdom; Jo.Hockenhull@bristol.ac.uk

The interaction between horse and rider is mediated by the use of tack and other equipment. The plethora of equipment available for the ridden horse raises the question of how riders select the most appropriate for their horse, their skill level and the work they undertake. Concerns have been raised that riding equipment may be used as a quick-fix to suppress behavioural symptoms of an underlying training issue rather than addressing the cause of the problem through re-training. An open-ended question was included in a horse-level internet survey that covered equipment and training practices used by UK leisure horse owners. Respondents were asked to explain why they used the equipment they did on their horse. Of the 1324 survey respondents, 1036 completed the question. The responses were coded into broad themes according to content. A multiple response coding strategy was used to allow each response to be coded under multiple themes. Coding was conducted using NVivo 7 software for qualitative data analysis. Twenty-six key themes were identified. The most commonly cited were that the equipment was chosen because the horse goes well in it (26% N=269) and to help the rider to control the horse, either as a necessity or as a precautionary measure (17% N=173). Some respondents stated that certain equipment was only required on specific occasions, e.g. when competing or hunting, rather than every time the horse was ridden (15% N=158). Equipment was used to tackle a particular evasion by the horse (11% N=118) or as a training aid (11% N=115). Some riders reported always using certain equipment as a personal preference or because it came with their horse (7% N=72); others reported that specific items of equipment, e.g. breastplates and running martingales, were used primarily to stabilise and reassure the rider rather than through a need directly arising from the horse's behaviour (4% N=42). The choice of equipment for the ridden horse has significant welfare implications. Many of the items available to riders are potentially aversive, especially if used incorrectly. There is also a risk that riders may be tempted to use increasingly severe gadgets to address issues, such as a lack of control that would be better resolved through re-training.

The findings of this study contribute to our understanding of what motivates a rider's choice of riding equipment for their horse, enabling areas requiring further investigation, and improved rider education, to be identified. The reliance on equipment to control the horse is a key area to address in future studies.

Visual laterality in the domestic horse (*Equus caballus*) interacting with humans

Farmer, K.[1] and Krueger, K.[2], [1]University of St Andrews, Centre for Social Learning & Cognitive Evolution, School of Psychology, St Andrews, Scotland KY16 9JP, United Kingdom, [2]University of Regensburg, Biologie 1, Universitätsstraße 31, D-93053 Regensburg, Germany; katefarmer@utanet.at

This study investigates whether horses show visual laterality in association with people as they do when observing inanimate objects. We gave 14 conventionally trained horses the choice of entering a chute to the left or right, with and without the passive, non-interactive presence of a person unknown to them. 13 of the horses preferred the left eye for scanning under both conditions (P<0.002), and this tendency was significantly stronger when a person was present (Wilcoxon matched-pairs signed-ranks test W+ = 0, W¡ = 36, N=14, P=0.008). One horse showed the same pattern, but preferred the right eye. Traditionally, riders handle horses mainly from the left, so we repeated the experiment with 12 horses specifically trained on both sides. 9 showed a consistent preference for left eye scanning in the presence of a person, which was stronger with an unfamiliar than a familiar person, but not significantly so (Wilcoxon matched-pairs signed-ranks test: W+ = 32, W¡ = 46, N=12, P=0.6). 2 horses showed the same patterns, but preferred the right eye. We also examined horses' eye preferences when approaching a person in an interactive situation. 24 out of 26 (binomial test: P<0.0001) of the conventionally trained and 12 out of 13 (binomial test: P=0.003) of bilaterally trained horse (92% in each respective group) preferred the left eye for viewing the person. For those horses tested under both passive and interactive conditions, the left eye was preferred significantly more during interaction (Wilcoxon matched-pairs signed-ranks test: W+ = 45, W¡ = 0, N=10, P=0.004). We suggest that most horses prefer to use their left eye for assessment and evaluation, and that there is an emotional aspect to the choice which may be positive or negative, depending on the circumstances. This is consistent with the theory that the left is the 'rapid response' side, and we believe this has important practical implications for welfare and training methods.

Horses are often unwilling to lunge, or to be led or handled on one side, usually the right. We compared how groups of left biased and bilaterally trained horses position themselves in relation to people, and found that horses choose to put the person on the left in up to 92% of instances. This suggests a sensory and or emotional laterality, and this preference, and the factors that moderate it, has important implications for handling and training.

Visual attention in Grand Prix dressage judges

Wolframm, I.A., Schiffers, H. and Wallenborn, A., University of Applied Sciences Van Hall Larenstein, Droevendaalsesteeg 2, 6708 PB Wageningen, Netherlands; inga.wolframm@wur.nl

The dressage judging system has recently come under fire in view of inconsistent scoring and variations amongst judges. This exploratory study investigates visual attention patterns of Grand Prix (GP) dressage judges. Seventeen GP judges at 5*, 4* and national level were recruited to take part in the study. All judges were asked to judge a horse-rider combination performing the 2009 GP test from a video while having their eye movement recorded using a Tobii T60 XL eye tracker. In order to identify patterns of visual attention, a checklist was devised listing all equine body parts judges may focus on while judging: head, mouth, poll, neck, shoulder, forearm, knee, front cannon bone, chest (front of the horse); croup, tail, thigh, flank, gaskin, hock, hind cannon bone (back of the horse); rider head, rider torso, rider hand, rider thigh, rider knee, rider lower leg (rider). Frequencies of judges' visual fixations on the different equine body parts for each movement were determined. Raw fixation frequency for each movement was transformed into percentage of total fixations. Differences between frequencies of focal points between front of the horse, back of the horse and rider as well as individual body parts of the horse were examined using repeated measures ANOVA with Bonferroni post-hoc comparisons. At the trot judges paid significantly more attention to the front of the horse (183.24±40.67; $P<0.0001$) than the back (114.47±32.47; $P<0.0001$) or the rider (54.76±21.58; $P<0.0001$). At the canter, judges also paid significantly more attention to the front of the horse (120.5±17.76; $P<0.0001$) than to the back (63.75±15.48; $P<0.0001$) or the rider (34.56±18.66; $P<0.0001$). Significant differences were found between fixation frequencies on different body parts for all movements. For example, in the piaffe and passage judges focused significantly more on the forearm than on the head, mouth, poll, neck or chest ($P<0.01$). Judges also focused significantly more on the hind cannon bone than on the croup, tail, thigh, flank, gaskin or hock ($P<0.01$). Large deviations in fixation frequencies were detected across all movements. For example, in passage and piaffe fixation frequencies on the hind cannon bone varied from 7-43% and 7-51% respectively. Despite the emergence of overall visual attention patterns, large deviations in fixation frequencies were also found, providing a possible explanation for inconsistent scoring.

While judges seem to pay attention to the front of the horse most frequently when assessing performances, the hind cannon bone features strongly in most exercises as a point of visual focus. In order to limit large differences in focus and scores among judges, visual attention training may be beneficial.

A review of rider reaction times in the horse-riding population

Williams, J. and Showler, K., University of the West of England, Hartpury College, Gloucester, GL193BE, United Kingdom; jane.williams@hartpury.ac.uk

Reaction time is defined as the elapsed time between the onset of a sensory stimulus and subsequent behavioural response. The study aimed to investigate reaction times of members of the horse riding population, testing for variables in subject lifestyles which affect reaction time including hand dominance, gender, age, sleep, caffeine and level of general and competition riding experience and considered the potential impact on rider safety. Fifty-three subjects (50 female, 3 male) participating in horse riding completed questionnaires including personal details and information on their normal lifestyle and equestrian involvement. Subjects completed one practice run at a computerised game designed to measure reaction time, cognitive and motor responses, to five integrated stimuli, then undertook six trials, three with the right hand and three with the left hand to. Reaction times were recorded and a series of Pearson's Rank Correlation Co-efficient (PRCC), Independent Sample T-test and Wilcoxens Signed Rank Tests were used to analyse appropriate data sets. No significant difference was found between reaction times of right hand (RH) and left hand (LH). A significance increase in reaction time was associated with an increase in age (PRCC: $r=0.744$, $P<0.05$). There was no significant variation between trials of the RH and LH, indicating an absence of learnt behaviour. Decreased sleep and caffeine ingestion prior to testing did not significantly influence reaction time (PRCC: $P>0.05$). The study identified that as subject age (years) increased, reaction time increased and, surprisingly, that the population did not appear to exhibit hand dominance proposed to be due to striving for a balanced rein contact. To fully assess the effect of sleep, stimulants and experience/competition level on reaction time, further investigation requires a larger number of elite equestrian athletes competing in a single discipline in the study sample. However, it can be concluded assessment of reaction time exhibits the potential to inform strategies to reduce injury or enhance performance in equestrian sports.

Identification of factors that impact on rider reaction times will allow these to be considered during equestrian human athlete development to enhance equine performance and reduce injuries to horse and rider.

Identifying interactive components of the horse–rider partnership during competition dressage

Bridgeman, D.J., Pretty, G.M. and Terry, P.C., University of Southern Queensland, Psychology, West St, Toowoomba 4350, Australia; djbridgeman@bigpond.com

Understanding the components of an effective horse-rider partnership is advantageous in developing and sustaining superior competition performance. Research that informs such understanding is limited because it has tended to rely on data from either horse or rider, but not from both simultaneously. Very few empirical studies have investigated physiological, psychological and behavioural factors involved in horse-rider interactions. The present study investigated whether anxiety and heart rate responses among competition dressage riders were associated with horse temperament, misbehaviour and heart rate. Seventeen horse-rider pairs competing in dressage competitions organised by the Equestrian Federation of Australia were studied. Riders completed the CSAI-2R and the horse HTI-R prior to commencing the dressage test. Heart rates of horse and rider prior to and during the test were recorded using polar S610 heart rate monitors. Horse misbehaviours (bucking, head tossing, shying, etc.) were subsequently coded by the researchers from video recordings of dressage performances. Thirteen of the 17 horse-rider pairs showed significant heart rate synchronisation (correlation) ($P \leq 0.01$) during the test. Rider ratings of horse misbehaviour correlated with the somatic anxiety scores of riders ($r=.50$, $P \leq 0.01$). Results of a stepwise discriminant function analysis showed that riders could be correctly classified into low vs high somatic anxiety groups with 70% accuracy ($F=7.87$, $P<0.01$) from horse temperament ratings, with more temperamental horses associated with higher somatic anxiety ratings by riders. Riders could be correctly classified into low vs high cognitive anxiety groups with 78% accuracy ($F=6.364$, $P<0.05$) from mean horse heart rate during the test, with higher horse heart rates associated with higher cognitive anxiety ratings by riders. No significant relationships between measured variables and dressage performance scores were identified, however. Findings suggest that riders' awareness and management of their experiences with their horses may promote effective physical and psychological competition preparation.

The study showed that a dressage horse and rider can be in tune physiologically, as evidenced by similar heart rate profiles. Associations between horse heart rate, temperament, and misbehaviour and the anxiety responses of riders were demonstrated. Knowledge of these associations may assist riders to manage the physiological and psychological components of training their horses to achieve an effective partnership.

Are horses lazy: horses' behaviour in preference tests for shorter and longer riding bouts

Keil, J.[1] and König V. Borstel, U.[1,2], [1]University of Guelph, 830 Prescott St., Kemptville, K0G 1J0, Canada, [2]University of Göttingen, ATW 3, 37075 Göttingen, Germany; koenigvb@gwdg.de

A Y-maze preference test was used to investigate, whether horses prefer a shorter riding treatment over a longer riding treatment. In a pilot study (n=4 horses), the maze was positioned with the two arms each pointing towards one of the short sides of the indoor arena, and in the main study (n=14), the maze was rotated by 90 degrees. Horses were 11±4.4 years old and ridden at various amateur levels regularly for at least 5 times/week. They were conditioned to associate one exit of the maze with two laps (R2) of riding at the walk or trot and the other exit with only one lap (R1) at the walk or trot (balanced for sides and gaits across treatments). Immediately afterwards, riders dismounted, horses were led into the maze, and let loose to avoid potential influences by the rider during their choice in the maze. After exiting the maze, the rider mounted again and rode according to the chosen treatment. This procedure was repeated until statistical significance ($P<0.05$) of preference according to a predetermined chart for sequential trials was reached. In addition, behavioural observations and heart rates were recorded. In the pilot study, all horses chose regardless of the associated treatment the left arm, which, however, pointed towards the arena's exit door. If horses were not caught immediately after exiting the maze (n=5 occasions), they walked or trotted straight to the door. In the main study, 4 horses significantly preferred R1, 2 horses R2 and for 8 horses no significant preference could be detected. Heart rates were significantly ($P<0.05$) higher during R2 (87.4±2.6 bpm) than during R1 (79.5±2.4), and the relationships were the same with occurrences of tail swishing (0.07±0.32 vs. 0.02±0.13) and averse reactions to the bit (2.5±3.4 vs. 1.3±1.9). Over the course of repeated trials, some horses became increasingly reluctant to enter and walk through the maze, and most showed increasing resistance to being re-mounted (e.g. side-stepping). Overall, the experimental set-up did not seem to be appropriate to answer the research question. Likely, the repeated mounting and dismounting caused discomfort or confused the horses to an extent that they did not actively select a treatment but rather that they searched for ways to evade further mounting (and riding). In particular, the pilot study demonstrated that horses' motivation to rejoin their herd-mates in the barn was greater than their motivation to being ridden.

Horses did not show a clear preference for either shorter or longer riding bouts, but their behavioural reactions indicate that they perceived mounting as stressful and that they preferred to return to the barn rather than being ridden at all.

Do horses like to jump: strategies used by leisure and sport horses

Górecka-Bruzda, A.[1], Jastrzębska, E.[2], Muszyńska, A.[2], Jędrzejewska, E.[2], Jaworski, Z.[2] and Jezierski, T.[1], [1]Institute of Genetics and Animal Breeding, Polish Academy of Sciences, Department of Animal Behaviour, Postępu 1, 05-552 Wólka Kosowska, Poland, [2]University of Warmia and Mazury, Faculty of Animal Bioengineering, Oczapowskiego 5, 10-719 Olsztyn, Poland; A.Gorecka@ighz.pl

Even though jumping is a seldom used strategy of negotiating obstacles by the free-living horses, show jumping is the most popular equestrian discipline. In order to establish whether horses are naturally motivated to jump, we examined strategies of negotiating obstacles used by horses in a free choice situation. Eighteen leisure (L) and 16 sport (S) horses were subjected to two choice tests. In the 'free choice test', the horses were presented with two optional routes to reach the stimulus food and social contact: the shorter one (over the obstacle) and the longer one (around the obstacle). In eight consecutive trials the horses were subjected to an increase in height of the obstacle in every second trial (0, 20, 35 and 50 cm). In 'under the rider test', after the initial conditioning, the horses were let to choose in three consecutive trials between arms of the 'Y-maze', one of which contained an obstacle. The strategy most frequently used by all horses was walking or trotting over the obstacle (59.9%), while jumping was used in only 11.1% of cases. For both the L and S horses, the motivation to traverse the obstacle decreased relatively to its rising height (only 44.1% of horses cleared the obstacle of 50 cm). The L horses chose walking or trotting over the obstacle more frequently than jumping it, as compared to the S horses (Pearson exact Chi-square test, Chi-square=11.74; df=1; $P<0.001$). In total of three trials under the rider, the L horses chose the arm of the Y-maze that contained no obstacle more often (Chi-square=12.52; df=1; $P<0.001$), while S horses showed no preference (Chi-square=1.33; df=1; $P>0.05$). No relationship was found between the total number of choices of the arm of the Y-maze that contained the obstacle and the number of successful trials (walking/trotting over or jumping the obstacle) in the 'free-choice test' (Spearman rank correlation, $r_s=0.08$; $P>0.05$).

Both L and S horses preferred to avoid unnecessary effort. Higher frequency of jumping in S horses could be related to initial selection for jumping ability and to the previous jumping training. Considering the reluctance to clear the obstacle of increasing height, it can be hypothesised that the horses may often be exposed to excessive demands and then their welfare should be carefully monitored.

The use of reflective practice to support mentoring of elite equestrian instructors

Winfield, J.R. and Macdonald, K., University of the West of England, Hartpury College, Gloucester, GL19 3BE, United Kingdom; kirsty.macdonald@hartpury.ac.uk

In the UK, many equestrian instructors are self-employed and receive no formal support for further self-development after completion of their lead body coaching qualification. However, continuing professional development (CPD) is essential to enable equestrian coaches to retain professional currency to promote both rider and equine welfare. Mentoring strategies routinely employed within the health and education spheres to promote staff development could have potential transfer to the Equine Industry to facilitate CPD. Three elite full-time instructors were selected through purposive sampling; all were BHS Instructors equivalent of UKCC Level IV standard with extensive prior teaching experience). The purpose of research was to assess cognitive awareness and behaviour of Instructors through analysis of qualitative data, therefore the methods adopted gave responses not suitable for inferential statistical analysis. Over a four-week period, weekly telephone conversations and a concluding focus group meeting were transcribed; the following transcripts were verified by the participants. The transcripts were subsequently investigated using inductive (emanation of new themes) and deductive (themes modeled on those in previous literature) content analysis. Pertinent quotations were grouped to create higher order themes which were then grouped to formulate emerging themes. Four reflective aspects (conscious awareness, image as professional, benefit to self and practical use of sheets) and four mentoring themes (refreshed and inspired, confidence in self, self-mentoring as coach and weekly support) emerged during qualitative analysis of participant transcripts. During this process instructors felt a positive cognitive awareness of their own ability allowing them to take ownership of their own practices developed. All considered the mentoring process supportive in aiding development of self-reflection. The results suggest that the use of a mentor supports the development of elite equestrian coaches. Limitations include the small population size and the use of a single investigator which could have introduced bias and influenced objectivity. However, the study serves as a pilot for adaption to produce a viable model for active integration into the equestrian coaching industry. Further research is warranted with reference to age, geographical location and experience of coaches.

Elite equestrian coaches in the UK are often isolated in their practice post qualification. Development of a remote mentoring scheme could enhance motivation and increase integration of current practices to promote improvements in horse and rider performance.

Horses' ability to learn an instrumental task by observation

Ahrendt, L.P.[1], Christensen, J.W.[1] and Ladewig, J.[2], [1]Aarhus University, Dept. of Animal Health and Bioscience, Blichers Allé 20, Postbox 20, DK-8830 Tjele, Denmark, [2]Copenhagen University, Faculty of Life Sciences, Bülowsvej 17, DK-1870 Frederiksberg C, Denmark; line.ahrendt@agrsci.dk

When applying new management systems to group housed horses, it would be beneficial if a few trained horses could facilitate use of the new equipment by naïve horses. However, previous studies found no evidence of observational learning in horses. This study aimed to investigate observational learning in horses applying a method where the observing horse could interact with the demonstrating horse during the demonstration. We examined the ability of horses (n=22, 2 and 3-year-old geldings) to learn an instrumental task from a familiar, trained Demonstrator (3-year-old gelding). The Demonstrator was trained to open an operant device with its muzzle to achieve a food reward. Test horses were habituated to feeding from the open device prior to the test, ensuring that the horses were motivated to investigate the device when closed. Observer horses (n=11) participated in ten successive demonstrations (duration approx. 7 min) immediately before they were given the opportunity to operate the device alone (3 min). Control horses (n=11) were presented to the operant device alone and were allowed ten minutes to operate the device. Accomplishment of and latency to a pre-set learning criterion (min. two openings) was recorded. Heart rate and time spent on a selection of behaviours during the first three test minutes were recorded. Five observer horses and one Control horse realised the learning criterion (however, no significant treatment effect; Fisher's exact test, $P=0.151$). Latencies to realise the learning criterion were also unaffected by treatment (Cox regression, $P=0.15$). However, Observer horses spent significantly more time on device oriented behaviour than Control horses in all three test minutes (random intercepts model, mean (s/min.); Observer & Control: min1: 47.9 & 27.5, min2: 37.8 & 17.4, min3: 35.2 & 14.8, s.e.=5.4, $P<0.05$). Both groups showed a significant decrease in time spent on device oriented behaviour over the three test minutes (random intercepts model, $P<0.01$). Participation in the demonstration did not significantly facilitate learning to operate the device in this study. Device oriented behaviour was, however, increased by the demonstration, which could be expected to facilitate learning. An additional experiment will be conducted using a larger sample size.

The increased motivation to explore the device by observer horses could increase the effect of individual training immediately after a demonstration by a trained horse. Trainers should be aware that motivation to explore a device declines rapidly after a demonstration if the explorative behaviour is unrewarded.

Behaviour and stress responses in horses with gastric ulceration

Poulsen, J.M.[1], Søndergaard, E.[1], Luthersson, N.[2] and Malmkvist, J.[1], [1]Aarhus University, Animal Science, P.O. Box 50, 8830 Tjele, Denmark, [2]Hestedoktoren, 4360, Kirke Eskilstrup, Denmark; Jens.Malmkvist@agrsci.dk

The prevalence of gastric ulceration is surprisingly high in horses according to several recent studies. However, very little is known about the consequences of gastric ulcers, and whether affected horses respond differently to acute stressors, which is of importance for both horse performance and welfare. We aimed to investigate whether horses with severe glandular gastric ulceration have a higher basal concentration of stress hormones, measured as faeces cortisol metabolites (FCM; analysed using an enzyme-immuno assay), and react differently (1) in a novel object test (NOT), and (2) during postponed feeding. Additionally, we studied whether eating behaviour and the occurrence of abnormal behaviour differ between horses with and without severe gastric ulcers. After gastroscopic examination of 98 Danish Warmblood horses (3-19 y) at one private stud, we selected two groups of horses: an ulcer group (n=30) with severe gastric ulcer lesion in the glandular mucosa (score 3-4) and a paired control group with intact gastric mucosa (n=30). Horses were then tested in a novel object test (NOT, Day 1), and exposed to a postponed feeding test (Day 2) in their home box. Faeces for determination of cortisol metabolites were collected before and after the NOT; heart rate was measured during the NOT, combined with behaviour recorded on video in both situations for later analysis. There was no obvious external signs, e.g. in body condition score, differing between control and ulcer horses. Controls spent longer time ingesting a small amount of feed given as part of the postponed feeding test (control: 126±10.2 vs. ulcer: 94±11.2 s, RM-ANOVA $P=0.025$), and spent more time moving during the test ($P=0.03$). We found no association between glandular gastric ulceration and the performance of abnormal behaviour (ANOVA $P=0.46$); crib biting was rarely observed (one ulcer horse only). Fearfulness (behaviour, heart rate) did not differ in the NOT; however, whereas the baseline FCM was equal between the groups (control: 5.3±1.93, ulcer: 5.7±2.03 ng/g; ANOVA $P=0.79$), horses with gastric ulcers showed a higher endocrine response after the NOT (7.3±0.81 vs. control: 5.8±0.79 ng/g, $P=0.02$). This may indicate that ulcerated horses are more responsive to acute stressors.

There was surprisingly little difference between groups of horses with and without severe gastric ulceration from the same stable, fed equal amounts of starch and hay; e.g. all horses were in good body condition and crib biting was rarely observed. Horses with severe gastric ulceration reacted, however, physiologically more after a novelty test, i.e. they may be more sensitive to novelty-induced stress.

A comparative study of pirouettes practised in the warm-up and subsequent performance in an elite (Grand Prix) level dressage competition

Mills, A.A.[1], Whitaker, T.C.[2], Kane, R.E.[1] and Murray, R.C.[3], [1]Writtle College, CEQAS, Essex, United Kingdom, [2]Duchy College, St Austell, Cornwall, United Kingdom, [3]Animal Health Trust, Newmarket, Suffolk, United Kingdom; Amy.Mills2@writtle.ac.uk

The necessity of the warm-up (WU) to physically and mentally prepare the athlete for competition is universally accepted. It is acknowledged that this preparation decreases injury risk and increases performance. Typically a WU consists of passive and general phases followed by a specific phase during which the athlete rehearses skills to be performed in competition. Specific components in the WU usually culminate in a number of efforts which are equal to the expected competition intensity. However, the precise protocol required in the WU leading to optimum performance is not established for the equine athlete. The aim of this study was to determine the relationship between the frequency of pirouettes practised in the WU and performance in subsequent competition. The total WU of competitors (n=15) undertaking a set dressage test (FEI Grand Prix B 2003) was observed. Analysis of the frequency of pirouettes in the WU was conducted using SportsCode GameBreaker (Sportstec, Australia). An ANOVA was performed to test for differences between judges mark and frequency of pirouettes in the WU; a correlation was applied to test for a relationship between combined movement mark in competition and frequency in WU. Mistakes were also recorded. The structure and performance of components within the WU was at the discretion of the rider and was therefore not standardised; horse and rider combinations had previous experience in competition at the level. A very weak positive relationship was observed between the combined pirouette mark and frequency [r=0.02, n=30, P=0.934]. There was no relationship between frequency of mistakes in pirouette and the average movement mark [r=0.02, n=30, P=0.502]. There was no significant difference (F=1.46, df=29, P=0.259) between the frequency of pirouettes performed in the WU and the scores awarded. However, there was an interesting pattern in the frequency grouping; combinations riding 0 (n=4) pirouettes in the WU achieved an average score of 6.6; those riding 1 (n=1) achieved 6.2; those riding 2+ (n=10) achieved 6.7. It would be valuable to review these variables again using a larger number of horse and rider combinations. An assessment of the additional components within the WU is required to establish whether the specific phase of the WU has an influence on competition performance.

A comprehensive understanding of the WU may assist the rider and trainer in preparing the horse to optimum performance prior to competition. This would have implications for performance as well as prevent over-exertion and strain on the horse in the warm-up phase of competition.

Start time and effect of order in the dressage phase of affiliated British Eventing (BE100 level) competition

Whitaker, T.C.[1], Randle, H.[1] and Mills, A.A.[2], [1]Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom, [2]Writtle College, Chelmsford, Essex, CM1 3RR, United Kingdom; amy.mills2@writtle.ac.uk

The dressage phase of competition is the first element of affiliated British Eventing competitions. Debate has taken place regarding possible biasing effects on scoring that may be occurring within dressage competitions. Horses and rider combinations are judged in a sequential order with up to 45 combinations (for British Eventing competition) being scored in one section. This study investigated the effect of start time of dressage sections (morning or afternoon) and the order a horse and rider combination was judged within a section. Data were collated from eighteen BE100 level affiliated eventing sections completed in March 2011. Penalty score achieved was used as the dependant variable (where lower score indicates better performance). All data were normally distributed. The overall mean penalty score for the sample population was 35.47±5.35 (n=566). Significant differences (df=17,548, f=4.44, P<0.001) were observed between sections with the lowest mean section score being 31.86±6.02 (n=25) and highest at 38.92 ±5.83(n=32). Eleven of the seventeen sections showed differences of significance (P<0.05), overall 9.37% of the total variance in scores was effected by section. Significant differences (d =563, t=3.06, P<0.05) were observed between morning 34.8±5.54 (n=289) and afternoon 36.16±5.09 (n=277) performances. An r=-0.108 (P<0.01) value was returned for the population with 1.2% of the scoring variability related to order (y=36.5-0.530x), with n=26 having a residual value ±10. Analysis demonstrated that 15 sections had a negative colleratory effect; as order preceded scores reduced. In 15 sections the order accounted for less than 4% of the score variability however in two sections it accounted for over 13%.

When the population is considered in totality it is suggested order is of limited effect on score. However there appears to be a difference of significance between morning (lower mean score) and afternoon (higher mean score) judged dressage sections. It would appear that there may be rogue sections that could challenge this assertion.

Pilot study on the occurrence of pressure marks on the body and of mouth lesions in riding horses in Flanders

Vervaecke, H., Boydens, M., De Nil, M. and Laevens, H., KAHO Sint-Lieven, Ass. KULeuven, Agro- & Biotechnology, Ethology & Animal Welfare, Hospitaalstraat 23, 9100 Sint-Niklaas, Belgium; hilde.vervaecke@kahosl.be

Riding horses (n=170) were examined to assess some management practices and the wounds or pressure marks apparent from hair discoloration on different horse body parts and in the mouth. The animals were kept at 13 different locations and were classified as horses kept for commercial public use (n=82) versus horses for private use i.e. owned by the usual rider (n=88). There were 82 geldings, 2 stallions and 86 mares (mean age: 13.5 years (range: 3-31). Differences among groups were analyzed by means of T-tests and GLM. We found that public use horses are less often shaven (16% shaven in case of public use versus 42% in case of private use) and that leg protection (26% versus 86%)($P<0.0001$) and blankets (18% versus 92%) ($P<0.0001$) were used more on horses for private use. Horses for public use were ridden during 118 minutes per day on average, versus 51 minutes per day for private use horses ($P<0.0001$), on average on 4.5 days per week for both (NS). The riders had on average 6 months of experience for public use horses versus 12 years for the horses in private use ($P<0.0001$). The latter participated on average at 6,1 competitions yearly versus 1,4 for the public use horses ($P<0.0001$). We found no significant difference in number of mouth lesions or in the sum of all pressure marks on the body (discolored skin patches on legs, spine, chest, head…) between the two categories of horses (private versus public). Number of pressure marks on the withers however occurred significantly more in private use horses ($P<0.029$). 72% of the 170 horses has at least one pressure mark on the body or a lesion in the mouth and only 28% of the horses was free from any mark or lesion. Only 47% of all horses was free from lesions in the mouth and only 50% was free from pressure marks on the body. Overall, we saw on average 2.15 lesions (SE=0.195)(i.e. sum of number of pressure marks on body and lesions in mouth). We observed mostly callus in the mouth corners (38% of all 170 horses) and thickening of the lower layers (15%). Wounds at the tongue or inner lip (6%), hollows in the layers (5%), torn mouth corners (0.6%) and wounds at the gums (0.6% of all horses) were also found. Most pressure marks on the body were seen on the withers (38% of all 126 marks) and the spine (24%), suggesting badly fitting saddles.

The results of a pilot study on 170 horses in Flanders show that 74% of the riding horses show some sort of pressure sores on areas of the skin where tack pressure can occur. This suggests that there is an urgent need to educate horse riders with regard to the wise use of bits and properly fitting tack.

Retrospective study of non-completion rates for the show jumping and cross country phases of one day British Eventing competitions (2007)

Whitaker, T.C.[1], May, E.[2], Randle, H.[1] and Mills, A.A.[2], [1]Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom, [2]Writtle College, Chelmsford, Essex, CM1 3RR, United Kingdom; amy.mills2@writtle.ac.uk

Non-completion rates in eventing competition have been reported up to 25% of competitors in some studies. Differences in non-completion rates are likely to vary between levels on completion. A greater understanding of non-completion rates is useful in developing methodologies that will help both horse welfare as well as the approach riders may use preparing for and within competition. This study conducted a preliminary investigation into the reasons for non-completion by level of competition. Data from 120 one-day eventing competitions were collected and non-completion in the show jumping and cross country phase was assessed. Data were discriminated by level of competition. Reasons for non-completion were categorised as elimination, withdrawal or retirement. Withdrawal is a voluntary decision taken by the rider before starting the phase, whilst retirement is a decision taken after starting the phase; elimination is forced exclusion this can be for a variety of reason including, failure to complete or attempt an obstacle or incurring a penalty score that breaches a ceiling. 42,180 entries started competition, the overall non-completion rate from starters was 18.91% (n=7978). Non-completion as a proportion of total starters was determined by level; Intro 28.52% (n=2,303), Pre-Novice 13.61% (n=2,519), Novice18.40% (n=2,215), Intermediate 24.97% (n=782) and Advanced 37.32% (n=159). The percentage of eliminations fell as the level of complexity of competition rose from70.1% at Intro to 17.0% at Advanced. The proportion of withdrawals rose consistently from 14.3% at Intro level to 69.5% at Advanced level 59.5%. The proportion of retirements rose with level; from 15.6% at Intro, 31.0% at Intermediate and 23.5% at Advanced.

Eliminations are the most common reason for non completion in lower levels of competition. At lower levels riders may continue to compete after accruing high penalty scores, potentially leading to a higher proportion eliminations or retirements. The lower proportion of eliminations in advanced levels of competition is likely to reflect the increased skill and better judgement of riders.

The relation between standing up behaviour of warmblood foals and prevalence of osteochondrosis differs between farms

Gezelle Meerburg, A.R.D.[1], Van Dierendonck, M.C.[2], Back, W.[1,3], Van Den Belt, A.J.M.[1], Van Schaik, B.[4] and Meeus, P.J.H.M.[5], [1]Utrecht University, Dept of Equine Sciences, Yalelaan 114, Utrecht, Netherlands, [2]Utrecht University, Behavioural Biology Group, Padualaan 8, Utrecht, Netherlands, [3]Ghent University, Dept of Surgery & Anesthesiology of Domestic Animals, Salisburylaan 133, 9820 Merelbeke, Belgium, [4]GD-Animal Health Service, Arnsbergstraat 7, Deventer, the Netherlands, [5]Ridderkerk Equine Clinic, J. Catsstraat 3, Ridderkerk, Netherlands; a.r.d.gezellemeerburg@students.uu.nl

Osteochondrosis (OC) is a common and clinically important joint disorder that is defined as a focal disturbance of enchondral ossification. The pathogenesis is multifactorial, but in most recent literature the failure of blood supply to the growing cartilage has been seen as a factor of major importance. Doubts about heritability of OC became clear when different joints appeared to be involved at different ages, so environmental factors are likely. Cartilage injury (with fragmentation) due to pressure changes when the leg slips, has been observed. We tested the hypothesis that there is an association between the way of standing up in foals and the development of OC. We observed the standing up behavior of 36 warmblood foals at the age of 8 months at 5 different farms, with different housing / bedding. Foals were observed using surveillance tube cameras, and stored on VHS videotapes (3-4 hours/day; total 24 hrs per farm). We scored whether there was a normal stand up (NS) or a slipping limb (SL). The standing up was scored by means of a predetermined ethogram. The incidence of OC was determined using a mobile x-ray machine and standard criteria (A=OC absent), B-E=OC present). In the preliminary results appeared to be a statistical difference between farms in the absolute number of NS observations/24 hr (mean±SD 3.4±2.5; $P<0.05$) and of SL/24 hr (mean±SD 1.8±2.3; $P<0.05$). The relative number of NS (% total registrations) varied on farms (mean±SD 73.1%±25.8%; $P<0.05$, n=5) as well as of SL (mean±SD 26.9%±25.8%; $P<0.05$, n=5). There was also a difference between farms in relative prevalence of OC (range 12.5-27.4% of joints affected). When farms were divided into low (<15%, n=2), medium (15-25%, n=2) and high (>25%, n=1) OC risk, there appeared to be a significant difference in prevalence of SL (L: 17.6%, M: 24.6%, H: 47.4%; $P<0.05$); high OC risk farms had the highest %SL.

In conclusion, the environment seems to have a significant influence on the prevalence of OC, related to standing up behaviour and limbs sliding. There seems to be an opportunity for farms to decrease the prevalence of OC in their foals through preventing foal limbs sliding while standing up.

What you see is what you get: investigating attractiveness of equine photographs

Wolframm, I.A. and Schnaudt, M., University of Applied Sciences Van Hall Larenstein, Droevendaalsesteeg 2, 6708 PB Wageningen, the Netherlands; inga.wolframm@wur.nl

Advertisements to sell horses via the internet or print media are almost always accompanied by photographs. It is assumed that a realistic representation of the horse is likely to entice the buyer into coming to try, and ultimately buy, the horse. Yet little empirical evidence exists identifying what type of photograph attracts potential buyers, nor what they pay attention to when looking at equine photographs. The aim of the current study was to investigate what type of photographs potential buyers find attractive and what elements in a photograph they focus on. A questionnaire was designed depicting 25 equine photographs commonly used when selling horses. The photographs were divided into three groups: action photos, head shots or side-on photographs. Twenty-one equine enthusiasts were asked to rate the attractiveness of each horse on a scale from 1 (not attractive at all) to 10 (extremely attractive) and subsequently decide whether they would consider buying the horse, assuming they were looking to buy. While completing the questionnaire, all participants had their eye movement recorded using the eye-tracker Tobii T60 XL. The visual attention data gained from the eye tracker were analysed using descriptive statistics for each group of photos. For each group different body parts were defined as areas of interest. Action photos included the areas of ears, eyes, mouth, neck, frontlegs, hindlegs, gender and rider. Head shots were divided into ears, eyes, mouth and neck, while side-on photos were composed of ears, eyes, mouth, neck, shoulder, frontlegs and hindlegs. Preliminary findings showed that areas most frequently paid attention to for action photographs were eyes (2.94±1.63), mouth (1.88±1.03), and ears (1.48±.79). Both for head shots, eyes (7.22±5.16), mouth (3.9±2.78) and ears (1.41±1.65) and for side-on photographs eyes (4.29±3.36), mouth (2.37±1.56) and ears (2.44±1.52) were focused on most often. Paired sample t-tests were subsequently conducted to determine significant differences in visual attention on eyes, ears or mouths between participants who would consider to buy the horse and those who would not. No significant differences were found between any of the groups with $P>0.05$. Findings seem to indicate that regardless of intent to buy, the most important areas of visual attention in an equine photograph are eyes, mouth and ears. Qualitative analysis of the photographs considered most attractive showed that the horses depicted all had pricked ears, an alert expression, and a mouth devoid of tension.

Practical implications are that when trying to sell a horse, the seller should take care to capture eyes, ears and mouth to express attention, alertness and freedom from tension.

A survey of the management practices and knowledge of natural needs of horses in Flanders

Konings, G., Laevens, H. and Vervaecke, H., KAHO Sint-Lieven, Ass. KULeuven, Agro- & Biotechnology, Ethology & Animal WElfare, Hospitaalstraat 23, 9100 Sint-Niklaas, Belgium; hilde.vervaecke@kahosl.be

We surveyed management practices and ideas about the natural behaviour and management priorities in horse owners in Flanders. Of 561 validly replied questionnaires, 125 respondents said they kept their horses 'in a traditional manner', 91 'in a natural manner' and 261 'in an alternative manner'. On a scale of 0 to 10 people thought that roughage (560 valid answers; x=9,46; SE=0.04; range=4-10) was a very important factor to fulfill the natural needs of a riding horse, followed by being able to go on the meadow (560 valid answers; x=9.08; SE=0.06; range=1-10), to have social contact (559 valid answers; x=8.92; SE=0.07; range=1-10) and lastly to train (560 valid answers; x=8.00; SE=0.08; range=1-10). Men score the need for social contact, roughage, and a meadow as less important than women, whereas the need to train was scored significantly higher by men than by women. Seniors thought the need for social contact to be less important than the other three age groups. The importance of social contact, training, and going on the meadow is scored lower by traditional horsekeepers than by natural or alternative horsekeepers. Training is scored higher by alternative than by natural horsekeepers. Roughage is scored equally by the three groups ($P<0.357$) (GLM and post-hoc tests). People think that wild horses graze 68% of their time (n=541 valid answers; SE= 0.7; range: 3-99%) and stand still 21% of their time (n=541 valid answers; SE= 0.6; range: 1-90%). They think wild horses walk daily on average 30.18 km (n=497 valid answers; SE= 1.41; range: 2-500 km). The perception of the daily distance covered by wild horses does not correlate to their score for the importance of training nor to their training frequency. There is however a trend to a significant correlation between the score for the importance of roughage for a horse and the idea people have about the time wild horses spend grazing ($r_s=0.077$, $P<0.073$, n=540), and both correlate significantly to the time their own horses can spend eating roughage (score of importance of roughage -time horse eats roughage $r_s=0.301$, $P<0.0001$, n=560; 0.110, $P<0.011$, n=541 idea of % grazing time horses spend eating roughage).

The results of a survey on management practices of horses in Flanders revealed that the ideas people have of natural behavior of wild horses correspond to their perceived management priorities for their own horses with regard to roughage but not with regard to training.

Independent observer pilot program: an objective evaluation method for determining humane handling and welfare during wild horse gathers

Greene, E.A.[1], Heleski, C.R.[2], Ralston, S.L.[3] and Stull, C.L.[4], [1]University of Vermont, 570 Main St, Burlington, VT 05405, USA, [2]Michigan State University, 1250 Anthony Hall, East Lansing, MI 48824, USA, [3]Rutgers University, 84 Lipman Dr, New Brunswick, NJ 08901, USA, [4]University of California, 1 Shields Ave, Davis, CA 95616, USA; betsy.greene@uvm.edu

In 2010, the American Horse Protection Association (AHPA) initiated an Independent Observer Pilot Program pursuant to their mission to protect and preserve America's wild horses and burros on US public range lands and to insure the humane care and handling of animals removed from the range by Bureau of Land Management (BLM) contractors and personnel. Goals were to 1. develop an assessment tool to allow objective evaluation of the handling, welfare, and care of horses before, during and after the gather process, 2. compile data regarding the care and handling of horses during the gather and transport process, and 3. identify potential improvements in the care and handling of the animals during gather and transport. Four equine academic professionals with strong backgrounds in horse behavior, health, and management, and knowledge of the standards for humane procedures for horse/livestock handling were selected to achieve these goals. Teams of two academics observed multiple days at three different gather sites. They had free access to (all) areas utilized and interviewed all personnel associated with the gathers. The BLM gathered a total of 1,224 horses, with 34 (2.78%) deaths, 4 of which were gather-related (0.33%). Teams observed the gathering of a total of 352 horses under a variety of circumstances over 11 days in three states (NV, OR, and CA), which included one gather under crisis conditions. In the Nevada gathers, horse overpopulation, drought, and animal activist delays of gathers caused dehydration in the free-ranging population followed by water toxemia at the gather site and death of 13 horses prior to the first gather observed. Proactive actions were taken by the BLM and contractors to review, assess, and adapt procedures (e.g. water trickle system to slow down initial intake) that prevented losses in subsequent gathers. The teams submitted written reports using the objective checklists developed to AHPA, which then compiled a formal report (http://tinyurl.com/3hzrcuv). The report provides details on the level of care and handling of horses observed during the gathers. It also provides positive, factual documentation that the BLM and contractors are responsible and concerned about the welfare of the horses before, during and after the gather process.

A pilot program was established using equine academic professionals to objectively assess the handling/welfare of wild horses during gathers and guidelines for assessment were developed.

A scientific approach of equitation should start with historical studies

Valere, N., Faculté des Lettres Université de Caen BAsse Normandie ED68, Art history, Esplanade de la Paix, 14000CAEN, France; nelly.valere@live.fr

Equitation is 5000years old, and a great number of treatises are available in private and public libraries, and now on the web.Since Xenophon, empirical knowledge has been examined increasingly with scientific insight, and our modern equitation can be closely examined and evaluated thanks to sophisticated technology. What is left of those 5000 years of oral and written experience? It is quite obvious that all the knowledge is seldom taken in account when evaluating and measuring practices nowadays, most studies and research being carried out on modern equitation as validated by medals in competition, in the one hand, and beginners' evaluation for a comparison, on the other hand. How true are modern practices to 5000 years progress in practice? Is it fair to forget about a tradition whose concern was at the same time efficiency, wealth, and finally art? It is remarkable that the effect of the curb-bit as understandable in La Guérinière's writings has never been scientifically studied and eventually validated, when the present use of it by riders who are supposed to be the best in the world is apparently so different, the branches drawn backwards by closed hands. Would the ground reaction forces be the same when evaluating a piaffer in high level competition nowadays and a piaffer executed according to the tradition as can be seen in private arenas? Those are examples of questions that should be addressed by modern researches. A society for equitation science cannot ignore or reject all the empirical knowledge of the past, and an exegetical study of the treatises whoul probably lead to an EBM-like approach. Such study could inspire interesting experiments, given that a number of unknown riders all over the world who have inherited thoses practices through masters from generation to generation, continue the tradition and would be happy to be involved in research.

Could practitioners be educated at school so that they can help their clients choose a better way of riding and schooling their horses?

Veterinarians' attitudes towards digital technology: an empirical study

Leskinen, S., Institute for Advanced Management Systems Research / Åbo Akademi University, Department of Information Technologies, Joukahaisenkatu 3-5 A, 20520 Turku, Finland; sleskine@abo.fi

At competitions horse identification and vaccination control takes much of the competition organizers time. FEI's clean sport initiative relies today partly on a paper based medication logbook. In this paper, the purpose is to find out what the bottlenecks in a veterinarian's daily routines are, how veterinarians use technology, and what their attitudes towards new technological innovations that could support their work are. A horse's medical information is not likely to remain with it throughout its life, since horses can be sold several times during their lifetime. With a functioning mobile- and internet-service and connecting it with an electronic database, we can ensure that a horse's identity and medical information remain with it throughout its life, and thus we get transparency into the whole industry. In this way, the identification and vaccinations of the horse can be easily checked at competitions and medical information checked by FEI testing veterinaries if necessary. We have carried out a survey and several interviews with riders, horse owners, competition organizers and veterinarians. During the survey and the interviews it became clear that the vaccination protocols as they are today are very cumbersome to use, and there is a need for improvements. Therefore during fall 2010, a new survey was conducted with Finnish veterinarians, to get a more thorough picture of the situation from their point of view. The veterinarians chosen for this survey were listed as either practicing equine medicine a/o official county veterinarians (N=511). The response rate was 31.5%. Veterinarians who listed themselves as treating horses and production animals, i.e. the veterinaries who most likely make house calls, definitely agreed (14.3%) or somewhat agreed (39%) that they could improve the way they keep records during house calls. Also over half of these veterinarians would use a mobile device if it improved their work performance. The majority of the veterinarians would use a national medical database for horses (70.8%). The equine medicine veterinarians agreed or somewhat agreed that they would be comfortable to share, in a database, diagnostic data (96.3%), medical data (98.8%), treatments (92.8%) and vaccination data (98.8%). The various stakeholders are interested to use information systems and mobile technology as help tools, but it is important that these tools are easy to use and useful.

In this research the aim is to find out what the bottlenecks in a veterinarian's work are and how some of these bottlenecks could be solved with technological innovations. A study with veterinarians showed that mobile and IS tools could be a solution.

A survey of 'equine-assisted intervention' programmes and welfare implications in the Veneto region (Italy)

Martin, S.[1], Meers, L.[1], Normando, S.[2], Samuels, W.E.[3] and Ödberg, F.O.[1], [1]Ghent University, Laboratory for Ethology, Heidestraat 19, 9820 Merelbeke, Belgium, [2]Università di Padova, Dipartimento di Scienze Spermentali Veterinari, Viale dell Università, 35020 Agripolis Legnaro, Italy, [3]CUNY, College of Staten Island, Victory Boulevard, Staten Island New York, USA; lieve@therapiemetdieren.be

Equine-assisted interventions (EAIs) include equine-assisted activities (EAAs), equine-assisted therapy (EATs), and equine-assisted learning (EAL). The Veneto region is one of the few in the world endeavouring to control these programmes by law. The purpose of this study was to gather information on selection, training, working conditions, and welfare of horses employed in EAIs conducted at riding stables in Veneto, identify possible welfare problems, assess whether there are gender differences relating to horse selection and reaction to people with challenges. Out of 144 riding stables, 83 (58%) were reached and 72 were participating in the survey. Thirty-one (37%) of the riding stables and 26 (36%) of the respondents reported conducting EATs. Seventeen (55%) of the 26 stables that initially declared organizing EATs completed the survey. Nine (52%) have a therapist present (EATs); four (24%) yards work with doctors, but they are not present; and four (24%) allege to conduct EATs, but do not meet requirements. The 14 yards conducting EAIs employed a total of 88 equids (39 mares, 49 geldings). Eighty five percent of the EAIs focus on people with disabilities. Nine (52%) followed a course in 'hippotherapy'. Only 14% of EAI equids received preliminary training. Equids were mainly selected by temperament (94%) and breed (42%). More male respondents considered age to be an important criterion than did female respondents ($P=0.004$). No yard deemed previous veterinary examinations necessary. All horses are regularly vaccinated and wormed. Retirement age varies depending on health. Workload varies from <20 minutes to 4 hours per session, the latter in EAT sessions, from 1 to 6 days a week. Individual boxes are the most common housing (64%), some (14%) are turned out for a couple of hours a week, and some (22%) have a box with free access to a field. The public has no access to the stables in 7 (41%) yards. Horses have free access to water in 8 yards (47%), food is in all stables available at specific moments, and only 1 (5%) yard provides environmental enrichment. No yards systematically assess possible discomfort or stress. Six (35%) yards report dangerous behaviours (e.g. running away, some bucking, or minor biting) toward clients.

Although the Veneto Law was passed to improve welfare of horses and clients, it does not seem to have been consistently implemented. This warrants further investigation. Practitioners should be aware of the importance of systematically monitoring and ensuring welfare in EAI.

Group composition and behavior of *Equus hemionus* near a water source in the Negev Desert

Bouskila, A.[1,2], Renan, S.[1,2], Speyer, E.[2], Ben-Natan, D.[1], Zaibel, I.[1] and Bar-David, S.[2], [1]Ben-Gurion University, Life Sciences, P.O. Box 58, 84105 Beer Sheva, Israel, [2]Blaustein Institutes for Desert Research, Mitrani Dept. of Desert Ecology, BGU, 84990, Midreshet Ben-Gurion, Israel; bouskila@bgu.ac.il

The Asiatic Wild Ass, *Equus hemionus*, was once abundant in western Asia. The species declined due to hunting and habitat loss. Between 1982-93 38 *E. hemionus* (21♀ 17♂) were reintroduced to the Negev Desert, Israel. Saltz, Rubinstein and co-workers studied the released population till 1999. The current population in the Negev is estimated at more than 200 individuals, yet, their social structure is not known. Here we report group composition and behavior of *E. hemionus* near a water source. We recorded and videotaped in 2010 group composition and social interactions from a shelter, 150 m from the water source. Not all wild asses were individually identified, but so far, we created 97 individual profiles (27♀ 70♂) based on photos, and recorded in which groups were they videotaped. Individuals were recognized with certainty up to 9 times, but 73 individuals were identified only once. Before reaching the water source, wild asses often aggregate in large groups and wait for the first few individuals to approach cautiously the water, and only then the rest of the individuals make a swift final approach. We did not consider these aggregations as social groups. We defined a group when individuals approached or left together the valley in which the water source is located. Female groups (including those with a male) were larger than male-only groups (9.8 and 5.1 individuals, range 2-49 and 1-34, respectively; P=0.0191). Individuals appear on different days in groups of various sizes and compositions. The highest proportion of juveniles per female was seen in Nov. (0.74, P=0.04) and this value is comparable to that found in the 1990's study (0.75). Except for Sep., fewer adult females were observed compared to males (P=0.028). Different daily activity patterns of the two sexes may explain this observation. The study of variation in social structure of wild Equids will enhance our understanding of the evolution of social systems in domestic horses and will improve the design of their boarding conditions (e.g. in better design of 'Paddock Paradise').

Wild Asses that were reintroduced in the Negev Desert about 20 yrs ago show a social structure compatible with fission-fusion of groups. The ratio between juveniles and females did not change from an earlier study, soon after the release. Females were observed near the water source less frequently than males, possibly due to different activity patterns. The study of variation in social structure of wild Equids will improve the design of boarding conditions for domestic horses.

Alternative methods of combating of gastrointestinal parasites in horses

Jagła, E. and Jodkowska, E., Wrocław University of Environmental and Life Sciences, Department of Horse Breeding and Riding, Kożuchowska 5a, 51-631 Wrocław, Poland; ewelina-jagla@wp.pl

The purpose of this review is to present the current state of research on combating equine parasite by natural methods. In a horse's body there exists a wide diversity of parasites, of which strongyloides (Strongylidae) form a significant group of nematodes, which are dangerous for a horse's health and life. Because of their short life cycle and problems with drug resistance to benzimidazole, eradication of nematodes is not effective. Consequently, combating Strongylidae should remain a priority in many situations including stables, pastures and horse management. Disinfection of stables should be carried out at least twice a year: before and after pasture season. To avoid infection by parasites that can be found in beddings, horses should be fed from hay nets, not from stable beds. The appropriate management of horse grazing also seems to make a noticeable impact on the reduction of parasite invasion. It is necessary to put to graze horses of different ages or to graze horses with other animals like sheep, goats or cattle. This leads to the break-down of a parasite development cycle within a given animal species. The right pasture management is essential to decrease the invasion of parasites and includes: liming, mowing down of refuse, draining of marshy grounds, faeces removal. In a pasture, plants with anthelmintic effect should be planted. There are several plants with deworming effect: Artemisia absinthium, Allium sativum, Juglans nigra, Cucurbita pepo, Cucurbita moschata, Artemisia vulgaris, Foeniculum vulgare, Hyssopus officinalis and Thymus vulgaris. Results from many studies conducted by different authors clearly point towards the anthelmintic action of fungi naturally occurring in the environment. Fungi attack nematodes being a source of nutrients for them. The efficacy of using Duddingtonia flagrans fungus in fighting against gastro-intestinal nematodes, including strongyloides in horses, has been especially emphasized. Unfortunately, the application of Duddingtonia flagrans in practice has many difficulties. These are connected with a shortage of ready to administer spore forms on the market and also with a registration of the product on the European market.

For the appropriate protection of both equine health and the surrounding environment, alternative methods of parasite extermination should become more often recommended. In order to decrease parasite invasion in the equine industry it is essential to: take care of stable hygiene, maintain recommended pasture management and use natural supplements against parasites.

Expression study for the sensitivity for insect bite hypersensitivity in Belgian Warmblood Horses

Peeters, L.M., Schroyen, M., Coussé, A., Somville, A., Dekeyser, K. and Buys, N., KU Leuven, Biosystems, Kasteelpark Arenberg 30, 3001 Heverlee, Belgium; lies.peeters@biw.kuleuven.be

Insect bite hypersensitivity (IBH) represents a type I and type IV hypersensitivity to presumably salivary antigens from numerous Culicoides species and possibly other insects. The prevalence of IBH in Belgian Warmblood Horses (BWH) is 9.4% in Belgium so IBH is a serious problem in BWH. Until now, there is no curative treatment but there are clear indications that the susceptibility for IBH is heritable. The identification of genes that influence the sensitivity for IBH can lead to the development of a marker assisted selection method. Based on literature, two candidate genes were selected: interleukine-4-receptor (IL4R) and the chemokine CCL5 of RANTES (Regulated upon activation normal expressed T-cell secreted). Allelic variation in both genes are associated with atopic dermatitis and asthma in humans (both type I hypersensitivities similar to IBH). Twelve horses (6 IBH positive and 6 IBH negative) were selected for this expression study with realtime PCR. All IBH positive horses had clinical symptoms at the time of sampling and the IBH negative horses never had shown clinical symptoms and were stabled together with the IBH positive horses so Culicoides contact was assured (case-control set-up). Whole blood samples (9 ml) were collected from all horses during the summer of 2010 (June-August) using Venosafe™ K2-EDTA tubes by jugular venipuncture and used within 6 hours. Mononuclear cells were isolated from peripheral blood by density gradient centrifugation using Ficoll paque™ and stored in Trizol at -80 °C until extraction of RNA using the phenol chloroform method. Expression levels of IL4R and CCL5 were measured using qRT-PCR with the relative standard curve method. Three stable housekeeping genes (GAPDH, ACTB en B2M)with an average expression stability lower than 1.5 were selected using GeNorm. No differential expression was found for IL4R and CCL5 in mononuclear cells isolated from peripheral blood (P=0,5483 and P=0,4874).

Insect bite hypersensitivity (IBH) is an allergic reaction to Culicoides. There is no curative treatment for IBH, but since there is a genetic predisposition, a genetic analysis may lead to the development of a marker assisted selection method (MAS). MAS will make it possible to select on the sensitivity for IBH, hereby reducing the prevalence in the population.

Review on biomechanical interaction between horse and rider

De Cocq, P.[1,2] and Van Weeren, P.R.[3], [1]Wageningen UR, Experimental Zoology Group, P.O. Box 338, 6700 AH Wageningen, Netherlands, [2]HAS Den Bosch, Biology, Animal and Environment, P.O. Box 90108, 5200 MA 's-Hertogenbosch, Netherlands, [3]Utrecht University, Department of Equine Sciences, Yalelaan 114, 3584 CM Utrecht, Netherlands; P.deCocq@hasdb.nl

The aim of this review is to provide an overview of possibilities to study the biomechanics of the interaction between horse and rider and the outcomes so far. To control speed and direction of a horse, several interfaces between horse and rider can be employed. Ridden horses are normally equipped with a bridle and a saddle, which serve as the main transmitters of signals from the rider. The tack often is connected to both horse and rider and therefore is suitable to incorporate measuring devices. The most commonly used tools in this respect are strain gauges. Strain gauges can be used to assess forces on bits, reins, and stirrups. Furthermore, flat normal force sensors are incorporated in pads which can be placed underneath the saddle, underneath blankets or even between the horse and the rider's legs. The instrumented tack can not only be used to study the effect of tack itself, but can also be used to study the interaction between rider and horse. Research on the effect of the bridle has initially focused on the bit. As a large part of the bit is hidden from view, fluoroscopic techniques have been used to evaluate the position and action of several bits. A next step was to objectify the force that riders apply to the reins. In several studies force sensors have been attached in-between bit and reins to measure rein forces. The research using saddle measuring devices has primarily focused on the effects of saddle pads and saddle fit, but the technique, in combination with kinematic measurements, can also be used to evaluate the biomechanical interaction between horse and rider. Riders have a direct and indirect biomechanical effect on the horse through their body mass and through the aids with which they actively try to influence locomotion. The main mechanical effect of riders on the horse is the gravitational force elicited by their mass. The distribution of this weight on the horse is also an important factor. The effect of the rider on the horse is further modulated by the riding technique of the rider and, associated with this, the level of riding. All these aspects are topics of studies on the biomechanical interaction between horse and rider.

The studies performed on the biomechanical interaction between horse and rider have yielded interesting results, partly confirming, partly negating long-held equestrian beliefs. The outcomes of this type of research may further our understanding of the impact of a variety of equestrian practices on equine welfare and help in the discussions on ethics and associated regulatory affairs.

Heart rate, heart rate variability, salivary cortisol concentration and superficial body temperature in horses lunged with hyperflexion of the neck

Aurich, C.[1,2], Becker-Birck, M.[1], Schmidt, A.[1], Wulf, M.[1], Von Der Wense, A.[3], Möstl, E.[4], Berz, R.[5] and Aurich, J.[6], [1]Graf Lehndorff Institute, Hauptgestüt 10, 16845, Germany, [2]Centre for Artificial Insemination and ET, University of Veterinary Sciences, Veterinärplatz 1, 1210 Vienna, Austria, [3]Equine Practice for Thermography, Rittergut Holdenstedt, 29525 Holdenstedt, Germany, [4]Divsion of Biochemistry, University of Veterinary Sciences, Veterinärplatz 1, 1210 Vienna, Austria, [5]Inframedic Medical Thermography Systems,, Walldorf, 64546 Moerfelden-Walldorf, Germany, [6]Section for Reproduction, University of Veterinary Sciences, Veterinärplatz 1, 1210 Vienna, Austria; christine.aurich@vetmeduni.ac.at

Bringing the neck of ridden horses into a position of hyperflexion, although discussed controversially, is widely used as a training aid in equestrian sports. In our study the hypothesis was tested that hyperflexion is a stressor for horses. Salivary cortisol concentrations, cardiac beat-to-beat (RR) interval, heart rate variability (HRV) and superficial body temperature (thermography, circle between caudal aspect of the mandible and ventral and dorsal lines of the neck) were analysed in sport horses (n=16) lunged on two days. The neck of the horse was fixed with side reins in a position allowing forward extension on experimental day A and fixed in moderate hyperflexion for 13 min on day B. Eight horses received treatment A first and B on the next day and 8 horses were treated in opposite order. Data were compared by ANOVA using a general linear model for repeated measures. In response to lunging, cortisol concentrations increased ($P<0.001$, day A from 0.73±0.06 to 1.41±0.13, day B from 0.68±0.07 to 1.38±0.13 ng/ml) but did not differ between days. RR interval decreased on both days ($P<0.001$, day A from 1486±66 to 821±66, day B from 1426±73 to 686±49 ms). Also, HRV decreased ($P<0.001$) but did not differ between days (standard deviation of RR interval: day A from 71±9 to 29±6, day B from 74±9 to 29±5 ms) In the cranial neck region, the difference between maximum and minimum superficial temperature was higher in hyperflexion (day A 3.2±0.2, day B 4.8±0.5 °C, $P<0.05$), indicating a lessevenly distributed temperature pattern. In conclusion, physiological parameters do not indicate a stress reaction of horses to transient, moderate hyperflexion at least without the influence of a rider but hyperflexion may affect blood flow and/or sweating in the neck region.

Lunging of horses in moderate hyperflexion and without a rider does not evoke a stress response in trained sport horses. Supported by Stiftung Forschung für das Pferd, the Austrian Ministry of Agriculture, Forestry, Environment and Water Management and the German Equestrian Federation.

The link between performance and heart rate in a known vs. novel environment

Christensen, J.W., Ahrendt, L.P. and Malmkvist, J., Aarhus University, Animal Health and Bioscience, Blichers Allé 20, 8830 Tjele, Denmark; JanneWinther.Christensen@agrsci.dk

The ability of horses to learn and remember new tasks is fundamentally important for its use by humans. Fearfulness may, however, interfere with learning, because stimuli in the environment can overshadow signals from the rider or handler. In addition, prolonged high levels of stress hormones can affect neurons within the hippocampus; a brain region central to learning and memory. In this experiment, we aimed to investigate the link between the basal level of stress hormones, measured as faecal cortisol metabolites (FCM), and performance and heart rate (HR) in a learning test, performed under either calm (home environment) or stressful (novel environment) conditions. Twenty-five geldings (2 or 3 years old) pastured in one group were included in the study. The horses were relatively unhandled prior to the study and were initially habituated to leading and being stroked with a whip on the body. Faeces was collected twice on control days where the horses had been undisturbed at pasture for 48 h. The learning test was based on negative reinforcement and performed by a professional trainer. The test included five predefined stages during which the horses were gradually trained to move sideways by crossing their front and hind legs on signal from the trainer (whip tapping). The first test was performed in the home environment and lasted 3 days; 7 minutes/horse/day. One month later, the same training stages were applied to the horses in a novel, outdoor environment. Performance, measured as final stage in the training programme, and HR were recorded. As expected, HR was significantly higher in the novel compared to the home environment (e.g. mean HR (bpm): One-way RM ANOVA; Home 53±1.1 vs. Novel: 65±2.9, F=14.6, P<0.001) and performance was significantly lower (Final stage: Home: 3.1±0.2 vs. Novel: 2.2±0.2, F=7.5, P=0.012). There was a significant, negative correlation between performance and HR in the novel environment (r_S=-0.66, P<0.001), whereas there was no such correlation in the home environment. Performance and HR did not correlate in the two environments. FCM levels were low (1st collection: 4.1±0.5 and 2nd collection: 4.4±0.7 ng/g) and did not correlate with performance nor HR in the learning tests. The experiments are part of a larger study, investigating the link between fearfulness, learning, basal stress levels and social rank in horses.

Riders and trainers should be aware that stressed horses are likely to have a reduced learning capacity. Horses that perform well in the home environment may not necessarily perform at the same level under stressful conditions due to interference by external stimuli. Horses' heart rate in stressful conditions can be used to predict performance.

A comparison between the Monty Roberts technique and a conventional UK technique for initial training of riding horses

Fowler, V.L.[1], Kennedy, M.[2] and Marlin, D.[3], [1]Institute for Animal Health, Ash Road, Guildford, Surrey, GU24 0NF, United Kingdom, [2] Anglia Ruskin University, Department of Life Sciences, East Road, Cambridge, CB1 1PT, United Kingdom, [3]Hartpury College, Hartpury House Gloucester, GL19 3BE, United Kingdom; veronica.fowler@bbsrc.ac.uk

This study describes the efficacy of the Monty Roberts horsemanship technique (MRT) in comparison to a UK conventional training technique (CT) for initial training of horses. Horses consisted of 14 untrained horses, 4 mares and 10 geldings between the ages of 3 and 5 years old. Horses were matched on temperament by assessing i) difficulty when being lead in hand, ii) behavioural reactivity to a novel object test prior to being randomly assigned to either MRT or CT. Trainers were selected in order to represent two differing styles of training horses. Monty Roberts (MRT) represented his own techniques whilst Phil Roelich, a conventional BHS registered horse trainer of 12 years, represented the conventional technique (CT). Each trainer was allowed 30 minutes per day to work with each horse for 20 days following which the horses undertook a standardised ridden obstacle and flatwork test and a ridden freestyle test. Heart rate during the daily training sessions and the final assessments was recorded using a Polar RS800CX system. Horses were scored for technical performance by a panel of judges who were blinded to the nature of the study and the trainers involved. During first saddle and rider MRT trained horse had significantly lower (P=0.0137) maximum heart rates (bpm) (First saddle: 127±37, first rider: 76±12) when compared to CT (First saddle: 176±24, first rider: 147±61). MRT trained horses had similar mean heart rates to CT trained horses (91±15 bpm, 80±7 bpm, respectively) during the ridden obstacle test but received significantly higher performance scores from the judges (171±4, 133±7, respectively; P<0.0001). MRT horses had similar mean heart rates to CT horses (81±13, 93±5 respectively) during the ridden flatwork test but were awarded significantly higher scores by the judges (149±9, 121±11, respectively; P=0.0005). Thus the efficacy of the MRT for initial training of riding horses is greater than CT as determined by significantly lower maximum heart rates during first saddle and first rider and significantly higher performance scores during standardised ridden tests following 20 days of training.

The use of Monty Roberts horsemanship methods before and during putting a saddle and a rider on a horses back for the first time, results in lower heart rates in horses when compared to using UK conventional horsemanship methods. In addition horses trained for 20 days using Monty Roberts horsemanship method perform significantly better in ridden tests than horses trained using UK conventional horsemanship methods.

Pressure distribution beneath conventional and treeless saddles

Clayton, H.M., Belock, B., Lavagnino, M. and Kaiser, L.J., Michigan State University, Large Animal Clinical Sciences, D202 Veterinary Medical Center, East Lansing, MI 48824, USA; claytonh@cvm.msu.edu

Many riders encounter difficulties in finding a saddle that is a good fit for both horse and rider. Treeless saddles are becoming more popular because they are thought to fit acceptably well on multiple horses and riders. The objective of this study was to compare weight-bearing area and pressure distribution patterns on the horse's back with a well-fitting conventional saddle and a treeless saddle. The experimental hypotheses are that the conventional saddle will distribute the force over a larger area of the horse's back and will have lower mean and maximal pressures than the treeless saddle. Eight horses were ridden by a single rider (57 kg) at sitting trot in a straight line in a conventional saddle and a treeless saddle. An electronic pressure mat measured total force, area of saddle contact, maximal and mean pressures over the loaded sensors, and area with mean pressure >11 kPa for 10 strides with each saddle. Univariate ANOVA ($P<0.05$) was used to detect differences between saddles. Mean force did not differ between saddles (mean±SD; conventional: 843±53 n; treeless: 794±42 N). Compared with the treeless saddle, the conventional saddle distributed the rider's weight over a larger area (conventional: 1,340±66 cm²; treeless: 1,153±94 cm²), had lower mean pressure (conventional: 6.3±0.2 kPa; treeless: 6.9±0.4 kPa), lower maximal pressure (conventional: 20.7±4.4 kPa; treeless: 29.4±3.8 kPa), and fewer sensors recording mean pressure >11 kPa (conventional: 10±15 sensors; treeless: 124±48 sensors). It is concluded that the saddle tree was effective in distributing the weight of the saddle and rider over a larger area of the horse's back and in avoiding high pressure areas. The treeless saddle had a relatively small area of loading and showed focal high pressure areas beneath the rider's seat bones. Future studies should evaluate different types of treeless saddles on different types/shapes of horses.

A pressure mat was used to compare pressure on the horse's back with a conventional saddle versus a treeless saddle. The conventional saddle had a larger weight-bearing area with pressure distributed along the length and width of the panels without focal high pressure areas. The treeless saddle had a smaller weight-bearing area with focal areas of high pressure beneath the rider's seat bones.

The use of the investigative behavior to improve the training of the jumping horse

Telatin, A., Delaware Valley College, Equine Studies, 700 Butler Av Doylestown PA, 18901, USA; angelo.telatin@delval.edu

Equine training is primarily negative reinforcement based. It is common among show jumpers to perceive the horse's alert reaction to a new fence as a challenge to the rider's aids. As a result, riders intensify the use of aids, which become stressors leading the horse's exhibition of fight or flight (FF) behaviors that end in a refusal to the jump. Our hypothesis is that horses allowed to perform investigative behavior (IB) to new fences will accurately assess the jump which will lead them to generalize their experience up to the point that the investigation time for new fences will not compromise the success of the jump. A case study approach was used as it is not ethical to purposely overpressure a control group. 50 horses ages 3-15 were evaluated, two age groups were considered: >8 years and ≤8 years. 43 horses were observed exhibiting behavior switching from alert to FF responses to a fence prior to entry into the study. 7 horses were trained using the IB. A training protocol was established to be used; at the first sign of alert behavior towards a new fence, the horse was not over pressured with the aids in the attempt to maintain forward motion and jump the fence. The horse was allowed to slow down and eventually stop and start the IB sequence without time constraints. Aids were maintained but not intensified. At the end of the IB sequence the jump was reattempted. The behavioral evaluation (BE) performed throughout a 6 month period of training was jumping a course in a competition situation. To prove the hypothesis, no refusals needed to be exhibited during the course. Data were analyzed using SPSS software. In the ≤8 years of age group, one horse did not perform. 24 horses age ≤ 8 learned to speed up the IB within the reasonable time required to approach a fence, eliminating the incidents of refusals. 1 horse performed in 1 month, 7 horses in 2-3 months, 12 horses in 4-5 months, 3 horses in 6 months. A non parametrical statistic chi-square test confirmed P<0.01. Horses >8, had controversial results chi-square test shows P>0.05; 15 horses reduced the number of refusals but failed the BE. 5 showed no significant change. 5 horses passed the BE only with certain riders. It seems that the rider's ability to allow the neck telescoping gesture toward the fence is the key factor. Further research is needed to prove this hypothesis.

Allowing the horse time to investigate a new fence until determination of its neutrality seems to be a successful approach to solve the problem of refusals in show jumping horses. Age is an important factor in the success rate of investigative behavior's ability to override the fight or flight response. Rider ability to assess the horse's response to a new fence is also essential in this approach.

The effect of type of bit on behavior and performance of horses

Van Der Horst, K.[1], Rijksen, L.[1], Ariëns, J.[1], Van Riet, A.[1], Timmerman, M.[2], Schreuder, M.[2] and Visser, K.[3], [1]HAS Den Bosch, Onderwijsboulevard 221, P.O. Box 90108, 5200 MA 's-Hertogenbosch, Netherlands, [2]NHB Deurne, Bruggenseweg 11a, P.O. Box 44, 5750 AA Deurne, Netherlands, [3]Wageningen UR, Edelhertweg 15, P.O. Box 65, 8200 AB Lelystad, Netherlands; hok@hasdb.nl

The effect of different types of bits on horse's welfare and performance has been subject to discussion. In this study the effect of a Myler-bit phase 2/3 (curved mouthpiece with tongue relief, double broken,11 millimeter,both bit pieces movable independently) on behavior and performance was compared to a regular bit (straight mouthpiece, single broken,18 millimeter). Fifteen Dutch Warmbloodhorses underwent regular training for three weeks with both bits used alternately. Afterwards, all horses were studied in two base-level dressage tests, one performed with the Myler-bit and one with the regular bit. The tests consisted of three subsequent time periods: (1) mainly paces sideways; (2) extended walk and canter; and (3) walking backwards and canter. During these tests six parameters were scored: heart rate variability (rMSSD;percentage of rest value), quantity of visible saliva, frequency of opening the mouth, on or off the bit positions, number of fluctuations in head-neck posture and tongue color. Three experienced jury members assessed the performance level using a standardized assessment protocol. External influences were limited as much as possible and all performances were videotaped. A Paired Sample T-Test was used to compare data and a binomial test was used to analyze data for tongue color. Results showed that horses performing the dressage test with the Myler-bit had a higher heart rate variability during time period 2 (respectively 44% versus 24%, P<0.05), indicating reduced stress. Additionally, these horses showed less (vertical) fluctuations in the head-neck posture (respectively 13 times versus 17 times, P<0.05), possibly indicating less time avoiding bit pressure. For five horses the quantity of the visible saliva was larger when ridden with the regular bit. For ten horses no differences were seen. It is assumed that horses ridden with the Myler-bit might swallow more easily and possibly show less visible saliva. The tongue colour could not be assessed reliably. No significant differences were found in the frequency of opening the mouth and the on or off the bit positions. The performance was not influenced by the type of bit used.

In the present study it was shown that horses ridden with a thinner bit with more freedom for the tongue (Myler-bit phase 2/3) showed signs of reduced stress, indicated by a higher heart rate variability and a lower number of fluctuations in head-neck posture. Additionally, these horses had an equal/smaller quantity of visible saliva, while achieving the same level of performance.

The effect of primary positive reinforcement administered by a TriggerTreater™ on the learning ability of the ridden horse

Lloyd, S.J.[1] and Lloyd, S.[2], [1]The Real Horse Company Pty Ltd, Anstead, Qld 4070, Australia, [2]University of Queensland, School of Veterinary Science, Gatton, Qld 4343, Australia; lloydsj@bigpond.net.au

Although scientists have found that Positive Reinforcement (PR) is beneficial for motivation, efficiency and quality of the training of many species of animals, direct primary PR for horses has, to date, been restricted to unmounted training. Ridden training for horses has relied mainly on negative reinforcement (NR). The PR apparatus, the TriggerTreater™, allows the rider to instantly deliver a direct primary appetitive reinforcer whilst riding. In this experiment eighteen mares and geldings of various age, experience, and breed were selected to represent a sample of riding horses and their riders. Using either primary PR in addition to NR (treatment) or using NR alone (control) it was determined whether horses could learn to halt from a novel stimulus (whistle) directly without a rein aid. Riders were not informed whether they were in the test group or the control group until the completion of the test. The test was limited to a single session of fifteen minutes for each horse. In walk, the rider began a whistle at the first marker and on the second marker the rider indicated solely by the reins that the horse should halt. Once halted, rein pressure was released and the whistle stopped. Horses in the experimental group received a primary PR from the TriggerTreater™, whilst the control group did not receive any PR. Training was repeated at the same point each time. Horses who halted from the whistle directly without the rein aid three consecutive times and then once more in a different place were deemed to have successfully learnt to stop on the novel stimulus of the whistle. Horses in the PR + NR group were significantly more likely to learn to halt at the novel stimulus than those in the NR only group (Wilcoxon rank sum test, $n_1=n_2=9$, $P<0.02$ two tailed test). Seven of the PR + NR experimental group horses took between 5 and 16 repetitions to learn to halt from the whistle alone. Two PR + NR horses did not learn the test. Eight of the nine horses in the NR only control group did not learn the test and the ninth NR control group horse took 19 repetitions to succeed. These results strongly suggest that the addition of PR in the training schedules of ridden horses will significantly improve learning outcomes leading to reduced costs in the horse industry and improvement of horse welfare.

A study of the learning responses of ridden horses using direct primary positive reinforcement using a TriggerTreater™ found that horses were able to learn to halt solely from a novel stimulus of a whistle in as little as five repetitions. Only one horse in the control group learnt the test.

Horse training: is there a difference between positive and negative reinforcement concerning effectiveness and stress related symptoms?

Hendriksen, P.[1], Elmgreen, K.[1] and Ladewig, J.[2], [1]University of Copenhagen, Biology, Universitetsparken 15, 2100 Copenhagen, Denmark, [2]University of Copenhagen, Production Animals and Horses, Groennegaardsvej 8, 1870 Frederiksberg, Denmark; katrine.elmgreen@gmail.com

The traditional way to train horses is by application of negative reinforcement (NR). Today, however, the use of positive reinforcement (PR) has become more common. To evaluate the effectiveness and stressor effect of the two training methods, 20 naïve 2-5 year old horses were trained to lead, stand and stay upon a hand signal. The horses were divided into two groups: one trained with NR and one with PR. The NR procedure consisted of various degrees of pressure (lead rope pulling, whip tapping). Pressure was removed as soon as the horse complied. The PR procedure consisted of clicker training. Heart rate was recorded and various HRV parameters calculated, furthermore behaviors reflecting discomfort and avoidance towards training were observed using one-zero sampling with 10 sec sampling intervals. Each horse was trained 7 min in 10 sessions with one day between each training session. A Mann Whitney U tests indicated that the NR group progressed further ($P<0.05$) and expressed more stress related symptoms ($P<0.05$) than the PR group in all stress related parameters. Generalized Linear Mixed Model analysis showed a decrease in the expression of discomfort behavior over time in the NR group ($P<0.05$), and an increase in the PR group ($P<0.05$). It was concluded that the NR procedure is more successful than the PR procedure in the training of naïve horses. Care should be taken though, to ensure that the stress level of horses trained with NR do proceed to decrease during training, in order to avoid welfare implications and potential dangerous situations due to an elevated stress response.

Positive (PR) and negative (NR) reinforcement do not relate to the mental state of the horse, but refers to the addition (PR) or subtraction (NR) of a stimulus, which will result in a behavioral change. The current study found that NR is more successful than PR in the training of naïve (untrained) horses.

Deciphering the cues from riders' legs

Hawson, L.A.[1], Koprinska, I.[2], Mc Lean, A.N.[3] and Mc Greevy, P.D.[1], [1]University of Sydney, Veterinary Science, University of Sydney, Sydney, NSW, 2006, Australia, [2]University of Sydney, Faculty of Engineering and Information Technologies, University of Sydney, Sydney, NSW, 2006, Australia, [3]Australian Equine Behaviour Centre, 730 Clonbinane Road, Clonbinane, Victoria, 3658, Australia; lhawson@gmail.com

Medially directed pressure cues from the riders' legs are an almost universal signal for acceleration across equestrian disciplines. We have developed a system for measuring critical variables involved in these signals: pressure, contact area, and duration of cue application. Twelve riders of varying experience seated on a saddled artificial horse torso were asked to give a cue for 'trot' they would usually give a well-trained horse every 20 seconds. This process was repeated 10 times over 200 seconds for each rider. REML analysis of calf-contact-area data during cueing showed that inter-rider variance accounted for 89.7% of total variance but that intra-rider variance was small (1.7%). Variance between applying and not applying the cue for each rider was 8.6% of total variance ($P<0.001$). Inter-rider variability in duration of change in calf pressure accounted for 72.1% of total variance; the remainder coming from intra-rider variability. 69.1% of total variance in calf pressure increases during cueing came from inter-rider variance. Variance between applying aid and not applying aid was 19.2% while intra-rider accounted for 11.7% of total variance ($P<0.001$). Duration of change in calf pressure indicated nearly equal intra-rider (48.4%) and inter-rider (51.6%) variance. These data suggest that, for an individual rider, changes in calf-contact-area cues for an upward transition may be more consistent than calf pressure changes but that, between riders, calf pressure changes are more consistent. Durations of intra- and inter-rider change for both calf pressure and calf-contact-area were inconsistent. This investigation has identified changes in rider leg cue variables, identified parameters of relevant stimuli in rider's leg cues and established base line measurements for these cues as well as identified sources of variablity in the upward transition cueing process.

We used pressure sensors on an artificial horse to identify attributes of rider leg cues as perceived by horses. Change in calf contact area during cue application was more consistent for individual riders but change in calf pressure was more consistent between riders. Duration of aid application was inconsistent. The variation of individual rider's leg cues was less than between riders. Further research will characterise leg cues in optimal riding technique.

Methodology for the use of rein tension meters in analyzing rein tension in the ridden horse (*Equus caballus*): a review

Davies, M.[1], Hawson, L.A.[2], Mclean, A.N.[3] and Mcgreevy, P.D.[2], [1]Nottingham Trent University, School of Rural, Animal and Environmental Sciences, Brackenhurst Campus, Southwell, Nottinghamshire, NG25 0QF, United Kingdom, [2]University of Sydney, Faculty of Veterinary Science, The University of Sydney, 2006, NSW, Australia, [3]Australian Equine Behaviour Centre, 730 Clonbinane Road, Broadford, 3658, VIC, Australia; meganaiki@hotmail.com

Bits have been used to control horses since 4,000 BC. As the bit rests in the diastema, a sensitive and physically vulnerable area of the buccal cavity, problems may emerge when used incorrectly. Excessive pressure in the mouth can damage oral tissues while relentless and inescapable aversive pressure may cause behavioral problems. We reviewed 14 published rein tension studies to summarize current accumulated knowledge and from there produce recommendations on methodological standards and future research directions. The merits of some previous studies have been compromised by insufficient sample sizes (one or two horses and up to ten or eleven riders or vice versa), little consideration of bit fit and the incorporation of locomotory activities that relate poorly to the 'real-world' activities required of the working horse. Analysis of these types of studies suggests that a minimum of ten horse-rider dyads are required to ensure statistical validity. Six of the ten locomotory studies recorded data at walk and trot in a straight line. While technology (including wiring issues and the lack of telemetry) may have previously limited the locomotory activities that could be integrated into rein tension studies, it is important that activities within these studies correlate to real world activities. Rein tension meters are now light enough to enable testing through gait changes and turns. Future work should address questions such as the effect of oral conformation on bit fit and horse/rider asymmetry. The conundrum of who is pulling whom needs to be addressed using accelerometry. Data resulting from these recommendations have the potential to revolutionize training, bit design and fitting.

The bit is crucial in traditional horse-rider communication. Tension applied through reins for deceleration and turns exerts pressure in the mouth. Excessive and relentless tension can lead to oral trauma, habituation and poor training outcomes. Recent studies have refined the technology, resulting in minimal load cell weight interference. Further research could revolutionize bit use.

Influence of the horse's laterality on rein tension in the rider's dominant and non-dominant hand

Kuhnke, S.[1], Dumbell, L.[1], Gauly, M.[2], Johnson, J.L.[3], Mcdonald, K.[1] and König V. Borstel, U.[2], [1]Hartpury College, Hartpury, Gloucestershire GL19 3BE, United Kingdom, [2]University of Göttingen, Albrecht-T.W. 3, 37075 Göttingen, Germany, [3]University of Worcester, Institute of Sport and Exercise Sciences, Worcester WR2 6AJ, United Kingdom; koenigvb@gwdg.de

The purpose of this study was to investigate the symmetry of rein tension in right-handed riders and the effect of the horse's laterality. Eleven right-handed riders rode both a right-lateralised and a left-lateralised horse. Laterality of horses was determined based on owners' responses to a previously validated questionnaire and confirmed by an established test for handedness in horses based on the preferred leg during approach of a feed bucket. Rein tensions were measured during three circles of walk, trot and canter and four walk-halt transitions in each direction, respectively. Tensions were recorded continuously using a rein tension meter, and data were analysed using a mixed model accounting for the effects of rider, gait, direction, side of rein, and laterality of the horse. Rein tension differed highly significantly (P<0.0001) between gaits (7.1±1.5 (walk), 10.6±1.5 (trot); 16.1±1.5 (canter), 15.9±1.5 Newton (N) (halt transitions)). The left-lateralised horse was ridden with overall higher mean tension in the left rein (14.7±1.6 N) compared to the right rein (13.7±1.6 N; P= 0.0352). In both horses, significantly higher tension was applied to the outside rein in a clockwise (13.7±1.5 versus 11.8±1.6 N for outside and inside rein, respectively; P= 0.0202), but not in a counter-clockwise direction (12.9±1.6 versus 11.8±1.6 N for outside and inside rein, respectively; P= 0.49). Less minimum tension per circle (right-lateralised horse, left rein: 0.06±0.14 N versus right rein: 2.7±0.14 N; left-lateralised horse, right rein: 0.08±0.14 N versus left rein: 3.6±0.14 N; both P<0.0001) as well as a higher amount of maximum tension occurred in the left rein of the right-lateralised horse and the right rein of the left-lateralised horse, indicating a less stead contact in the horses' non-preferred rein. Although the explanatory power of the present study is limited, the clear deviations from mirror-inverted patterns in rein tension indicate that the different utilization of left and right rein is likely to be influenced by the laterality of both, horse and rider. These circumstances are expected to impact horses' learning since consistency of stimuli is an important prerequisite for efficient learning.

Considerable differences in patterns of rein tension were found between a right- and a left-handed horse, for example, with less steady contact in the horses' non-preferred rein. However, handedness of the riders also seems to result in unequal rein tension patterns.

Effect of shortened reins on rein tension, stress and discomfort behaviour in dressage horses

Ludewig, A.K., Gauly, M. and König V. Borstel, U., University of Göttingen, Albrecht-Thaer-Weg 3, 37075 Göttingen, Germany; koenigvb@gwdg.de

Horses are commonly ridden with reins severely shortened compared to the theoretical ideal, e. g. by inexperienced riders in a mistaken attempt to achieve collection, to 'stretch' the horse's muscles, or to hold back a bolting horse. Therefore, the aim of the present study was to study naïve horses' reactions to riding with shortened reins. Seventeen dressage horses were each ridden by their riders in a dressage pattern (official competition patterns for German rider level A or L, depending on the skill level of the horse and rider) in balanced order twice with their normal rein length (mean ± SD: 79±7 cm; corresponding to a posture with the horses' noseline at the vertical as, according to the owner, usually used for this horse) and twice with the reins shortened by 10 cm. Horses' heart rates, rein tension, behaviour and length of steps were recorded and subsequently analysed with a mixed model. Shortening the reins by 10 cm resulted in steps shortened by 15±3 cm (walk) and 31±3 cm (trot) and an increase in rein tension by 10.2±0.25 Newton (all LS-mean ± SE; $P<0.05$), corresponding to an additional weight of about 1 kg in the horse's mouth. Horses' neck lengths (mean ± SD: 99±3 cm measured from the poll to the withers during the 'usual' posture) did not ($P>0.05$) influence these results, and heart rates did not differ between the two treatments, but with the shortened reins, horses chewed the bit less, opened the mouth more often, swished the tail vertically more often, and showed fewer bouts of moving ears and of ears pinned forward, while there were more bouts of flattened ears and of ears directed backwards when compared to rides with normal rein length (all $P<0.05$). In addition, the horses carried their head significantly ($P<0.05$) more often with the noseline slightly behind (28% vs 18.9% of the observations) or considerably behind (10% versus 1.6%) the vertical when ridden with shortened rather than normally long reins.

These results indicate that horses partly comply with the shortened reins by adapting their head posture, the step-length and by putting more pressure on the bit. However, the changes in behaviour such as the more frequent opening of the mouth and flattened ears indicate that the horses perceived this posture and/or the pressure on the bit as more aversive.

Rider perception of the severity of different types of bits and the bitless bridle using rein tensionometry

Randle, H. and Wright, H., Duchy College, Equitation Science, Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom; hayley.randle@duchy.ac.uk

While it has been well established that the bit can cause pain, and therefore behavioural problems, in the ridden horse, no studies have explored riders' perceptions of the severity of the bit in terms of the tension that they should be applied with. This study investigated riders' perceptions of the tension required to execute a standard movement namely a transition from walk to halt using bits belonging to different families. A ReinCheck™ was attached to a static box fitted with standard leather reins. 10 subjects, all experienced riders who were familiar with lorinary but naïve to the bitless bridle, were shown four different types of bit (jointed eggbutt snaffle, french link snaffle, pelham and a three ring continental gag with the rein on the bottom ring) and a Cross-Under Bitless Bridle based on the Dr Cook design. On taking up the reins (baseline) each subject was asked to imagine that they were riding a horse in a particular bit type and then to apply tension to the reins in order to halt. There were 3 replications per bit type per subject. Rein tensions (N) were extracted for (1) the baseline tension and (2) the increase in tension to halt from walk. No significant differences were observed in either the baseline and maximum tension applied with the right and left reins (both $P>0.05$). However, the type of bit 'used' significantly effects both the baseline tension applied ($F_{4,200}=61.30$; $P<0.001$) and the tension applied to halt ($F_{4,200}=158.51$; $P<0.0001$). Significantly less tension was applied with the gag, pelham and bitless bridle (1.98±0.52; 2.04±0.64 and 1.92±0.22 N respectively) than with either of the snaffles (2.29±1.11 and 2.34±1.09 N). A similar pattern was observed when exerting the perceived tension needed to achieve a halt from walk with very similar tensions being applied to the bitless bridle (2.94±1.00) as to the gag (2.76±1.18) and the Pelham (2.9±1.23). Again significantly greater tension was applied to the snaffles (3.32±1.52 & 3.45±1.44N). Through the collection of objective data this study has demonstrated that riders have clear perceptions of the severity of different bit types. Clearly the action and severity of bitless bridles is perceived as similar to that of the Pelham and the gag, despite them being marketed as a kind alternative to bits in general.

Riders perceive that more tension is needed to achieve the walk to halt transition with snaffle bits than with more severe bits. Futhermore the tension required to achieve walk to halt with bitless bridles is similar to that of the more severe bits.

Preliminary comparison of behaviours exhibited by horses ridden in bitted and bitless bridles

Scofield, R.M. and Randle, H., Duchy College, Equitation Science, Stoke Climsland, Callington, PL17 8PB, United Kingdom; devonheaven@mail.com

The use of bitless bridles has been advocated as an alternative to traditional bitted bridles in many equestrian disciplines to avoid bit injury and distress reported in previous research. Anecdotal observations and lay publications suggest the bitless bridle has become very popular amongst riders and horse owners in the United Kingdom. The bitless bridle has been compared favourably to the use of the bit in foundation training with improved performance reported for some horses in the bitless sample group. Similarly, improved dressage test scores have been attributed to the bitless bridle in schooling. However objective data do not exist on the use of bitless bridles for horses in the UK owned by leisure riders primarily for hacking, local shows and riding club purposes. The aim of this study was to compare the behaviours exhibited by horses wearing the bitless bridle with those when ridden in the usual bridle. Twenty subjects selected from a population of privately- and college- owned horses never having worn a bitless bridle were ridden by one qualified rider for a warm-up period of 30 minutes in the Dr Cook Beta bitless bridle. The subjects were then ridden in the Preliminary 4 British Dressage test in their usual bitted bridle and in the bitless bridle. Horses were allocated using a cross over design where half of horses wore the bitted bridle and then bitless, and the other half bitless followed by bitted. All tests were videoed with continuous recording of behaviour. An ethogram developed for the study was used to collate conflict behaviours exhibited. Assessment of pilot data (n=2 horses) demonstrated that 6 different conflict behaviours occur with both types of bridle (tail swish, open mouth, cow kick, hollow, fall out and pull down). The frequency of occurrence of each behaviour was recorded along with the total number of behaviours exhibited (Behavioural Intensity) for both conditions. Most frequent behaviours observed were tail swishing (14.5±12 for bitted; 23±19.8 for bitless), pulling down (3.5±3.5 for bitted; 5.5±2.12 for bitless) and hollowing (4±4.2 for bit; 3±4.2 for bitless). No significant differences were found for any behaviour or for behavioural intensity (Wilcoxon paired t tests; $P>0.05$). Preliminary analyses of objective pilot data suggest that the occurrence of conflict behaviour with the bitless bridle is similar to that observed with traditional bitted bridles.

The use of bitless bridles has increased in the leisure horse population. Despite bitless bridles being marketed as a ‘welfare friendly’ alternative to traditional bitted bridles analysis of pilot data suggest that this may not be the case.

A rubber/silicon bit to stimulate chewing in horses and its influence on heart rate variability

Vitale, V.[1], Cerchiai, A.[1], Sgorbini, M.[2], Sighieri, C.[1] and Baragli, P.[1], [1]University of Pisa, Department of Physiological Sciences, viale delle Piagge 2, 56124 Pisa, Italy, [2]University of Pisa, Department of Veterinary Clinical Sciences, via Livornese SNC, 56122, San Piero a Grado (PI), Italy; v.vitale@vet.unipi.it

The constant drag on the bit could lead to bone and temporomandibular joint pain that can subsequently cause rigidity of the neck. The natural movement of chewing can relax the neck muscles and benefit the temporomandibular joint. We checked a rubber bit covered with a silicon hose filled with candy and perforated with small holes to allow the escape of the juices. The purpose of this study was to evaluate whether this 'toy' could cause stress in the horses, by recording heart rate variability (HRV), a non-invasive method of estimating the activity of sympathetic and parasympathetic systems. A rise in HR is mainly caused by an increase in sympathetic activity but is also result from a decrease in vagal regulation or from simultaneous changes in both regulatory systems. HRV analysis allows a much more accurate and detailed determination of the functional regulatory characteristics of the autonomic nervous system.In particular a reduction of its variables, like standard deviation (SDRR), the root mean square of successive RR differences (RMSSD), and the geometric standard deviation 1 and 2 (SD1, SD2), means a shift toward sympathetic control of heart. Nine female trotting horses were used. For each horse heart rate (HR) and its variability (HRV) were recorded for 15 minutes consecutively in the stall first without (control phase) and then with (treatment phase) the rubber/silicon bit. HRV was recorded by the Life Scope 8, collected with the LabView Signal Express software and analyzed with Kubios software. HR, the mean beat-to-beat interval (RR intervals), SDRR, RMSSD, SD1 and SD2 were analyzed on 15-min data sets. Paired-sample t-test was used to compare results with and without the rubber bit. Results showed no differences between control and treatment regarding HR, RR intervals, SDRR and SD2. However, RMSSD ($t=2.32$; $P=0.049$) and SD1 ($t=2.30$; $P=0.049$) decreased significantly with the bit, showing a shift toward sympathetic control of heart rate. We may hypothesize that by modifying the thickness of the silicon horse and providing a more prolonged adaptation period, this type of bit could be used for short-term chewing periods.

Any bit is an invasive method of control but we have grown so accustomed to the bit that its physiological disadvantages have gone unrecognized. Chewing can help to realign the temporomandibular joint and thereby reduce muscle tension. This 'toy' could be a possible option to stimulate chewing without inducing stress reaction.

On the bit versus ‘dans la main’

Valere, N., Faculté des Lettres Université de caen Basse Normandie ED 68, Art history, Esplanade de la Paix, 14000 CAEN, France; nelly.valere@live.fr

Contact is the usual word for connection between rider’s hand and horse’s mouth. This term hardly means the same, according to the different theories and practices as are understandable in equestrian literature and observable on the field. Contact appears to be the key-point for all riders and horsemen. Horse’s welfare, more than equestrian technical concerns leads scientists to investigate about the best possible contact. There have been lots of experiments and scientific research about contact. According to the scientists involved in that kind of research, contact appears to be a measurable phenomenon: Preuschoft, Clayton, Geyer, Warren-Smith, have measured rein-tension, that tension being either the force exerted on the bit through the reins (traction) or the resultant of two opposite forces, one forwards from the horse’s mouth, the other one backwards from the rider’s hand and (or) body.A retrospective study has been made by investigating in ancient treatises and engravings on the one hand, considering the effect of the curb-bit on the mandibular of the horse, and observing some particular way of dealing with reins and bits on the other hand. All this show another kind of contact which cannot be characterized by a measurable tension of the reins. The technique of that contact is characterized as based on the opening of the temporomandibular joint, and was included in the FEI rules (art. 83) A retrospective study shows riders using that technique. The riders using that technique tell about the benefits they obtain, for the horse and for themselves. Vets and equine therapists deliver their empirical findings when observing the effects of the technique on the horse’s plasticity, locomotion and behaviour. Further research to study and evaluate the effects on horse and rider is proposed using EBM protocoles for prospective studies, Echosonography, Electromyography, Radiology, etc.

Great riding Masters of the Past were hippiatres and would give medical advice correlated to riding, whereas vets and equine therapists rarely interfere nowadays with the riding techniques of their clients. Findings concerning locomotion, plasticity and behaviour of the horse as related to a relaxed TMJ might greatly help prevention of lameness, better behaviour, comfort for both rider and horse, and brilliance as well as competitivity.

Survey of saddle pad usage and behaviour amongst equestrian riders

Hawson, L.A.[1], Mclean, A.N.[2] and Mcgreevy, P.D.[1], [1]University of Sydney, Faculty of Veterinary Science, University of Sydney, Sydney,2006, NSW, Australia, [2]Australian Equine Behaviour Centre, 730 Clonbinane Road, Clonbinane, 3658, Australia; lhawson@gmail.com

Increasingly, saddle fit is being studied with pressure detecting devices. Saddle pads of differing types and materials influence the amount and distribution of pressures recorded under saddles. There is little evidence that saddle pads can correct poor saddle fit. We designed an online survey (www.surveymonkey.com) to characterise saddle pad usage in the general equestrian community. We also asked participants to comment on the behaviour of the saddle pad/blanket during and after the ride. Of 1001 responses, 42% of respondents nominated dressage as their main riding activity followed by 25% trail riding. Other activities well represented included eventing, showing, show-jumping, endurance, and working cattle. The vast majority of respondents (98.6%) used some form of layer between the saddle and their horse's back and, of these, 84.5% pulled the layer up into the gullet of the saddle. 87.3% nominated the perceived horse's comfort as a reason for using a layer. Just under half (43.5%) claimed that the layer descended onto or near the spinous processes during riding activities. Of the 54.1% of respondents who used more than one layer under their saddles, 64.6% answered that the resulting thickness of the layers was greater than 1 cm. These results indicate that usage of at least one layer between saddle and the horse's back is commonplace in this population of riders. They have significant implications for any research on the ridden horse's back as layers of material under the saddle may disperse or concentrate the pressures. Given the high usage rates of saddle blankets/pads researchers are encouraged to consider the role of these layers in saddle and seat pressure measurement. Changing behaviour of saddle blankets/pads over the midline area is an issue that demands both researchers' and manufacturers' attention, as it may reduce the effectiveness of a saddle in distributing weight away from the dorsal midline.

We conducted a survey on usage of layers between saddle and horses' backs by riders in a variety of disciplines. Our data show that most ridden horses wear a layer under the saddle. Such devices need to be considered whenever pressures on the horse's back are investigated by researchers. Many riders reported that the layers move while riding and that using more than one layer under the saddle was commonplace. This may impact on dispersion of pressures under the saddle.

The effect of physiotherapy on asymmetry in pressure distribution through the seat

Nevison, C.[1], Guire, R.[2], Fisher, M.[3], Fairfax, V.[4], Thomas, A.[2] and Timmis, M.[1], [1]Anglia Ruskin University, Equine Research Anglia and Vision and Eye Research Unit, East Road, Cambridge, CB11PT, United Kingdom, [2]Centaur Biomechanics, 25 Oaktree Close, Moreton Morell, Warwickshire, CV359BB, United Kingdom, [3]Woolcroft Saddlery, Mays Lane, Leverington, Cambridgeshire, PE135BU, United Kingdom, [4]Fairfax Saddles, Fryers Road, Bloxwich, Walsall, WS32XJ, United Kingdom; charlotte.nevison@anglia.ac.uk

Equestrians are trained to apply bi-lateral pressure-based signals (aids) through their seat, hands and legs to communicate with and/or influence the movement of their horse. Although balance through the seat is acknowledged to strongly influence the horse, trainers and judges often comment that riders are 'crooked' or 'collapsed in the hip' and that this may not be percieved by the rider. Whilst asymmetry has received much attention in sports research little attention has been paid to equestrians despite the profound effects it may have on effective horse-rider communication, performance and welfare. This study examined asymmetry in distribution of vertical pressure in riders and the effect of physiotherapy to the lower torso in improving balance. Six competent female riders were assessed for medial-lateral postural stability in a sitting posture on a force plate (30s at 100Hz) and for left-right asymmetry in the area over which vertical force was distributed when sitting astride a static balanced saddle (10s at 50Hz). Three riders were then randomly assigned to receive physiotherapy* before measurements were repeated for all riders. Riders who received physiotherapy showed a significant reduction in medial-lateral fluctuations in displacement from the centre of pressure whilst sitting on the force plate (medial-lateral CoP excursion (RMS mm), mean ± s.e.; pre-intervention = 0.061±0.007; post-intervention = 0.038 ±0.009; paired t-test t=12.21, d.f.=3 P=0.007). An initial right bias in the area over which pressure was distributed was corrected by physiotherapy (difference in left-right area (cm^2), mean ± s.e.; pre-intervention = -12.89±2.35, post-intervention = 4.68±6.20; paired t-test t=-5.50 d.f.=2 P=0.032). *All riders were able to receive physiotherapy post-study if wanted.

Asymmetry in pressure distribution through the rider's seat may affect their ability to correctly influence the horse's way of going. This study demonstrated that physiotherapy to the lower torso can significantly enhance the balance of riders when sitting as on a chair and reduce left-right asymmetry in the area over which pressure is applied on the seat of the saddle.

The horse and rider bodyweight relationship within the UK horse riding population

Halliday, E. and Randle, H., Duchy College, Equitation Science, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom; hayley.randle@duchy.ac.uk

Equine sports involve two athletes, the horse and rider. Riders can directly affect the horse-rider performance; rider bodyweight (BW) tends to be ignored (horse racing being the exception with its strict rules regarding riding weight). Traditional methods of determining whether a horse can withstand the weight of a rider are not based on scientific principles. An industry practitioner proposes a 10% rider to horse BW ratio for optimum performance, 15% as satisfactory and 20% to be a welfare issue. The study objective is to measure the relationship between horse & rider BW within the general UK horse riding population. Data obtained are intended to be used in future studies to assist in the identification of rider to horse BW ratios to optimise ridden performance and welfare. The bodyweight (kg) of 50 horse-rider combinations (where all riders were ≥18 years) were recorded. Horse BW was measured using an Equest weightape, a cheap and practical alternative to scales, so laypersons can replicate methodology. Height (ground to point of wither, cm) was measured using a measuring stick. Rider BW (kg) was measured using calibrated EKS digital scales and height (cm) with measuring stick. Three BW measures were obtained per rider: W1 wearing breeches and a top (no footwear); W2=W1 plus footwear and hat, and W3=W2 plus saddle. Rider to horse BW ratio percentages was derived. Demographic data including age and gender for both horse and rider were also collected, along with riders opinion on their suitability in terms of their BW and height for the horse (using a 5-point Lickert scale). Riders (n=14) were of a healthy Body Mass Index (BMI) (23.32±0.71 kg/m^2) compared to NHS guidelines. Rider horse BW ratio for each rider weight category was: W1 14.2±0.83%; W2 14.63±0.85% and W3 16.59±0.94%. Typical rider height was 178±1.04 cm, and horse height 164.71±4.88 cm. In this study riders possessed a healthy BMI. Since observed rider to horse BW ratios varied between 14.2 and 16.6%, the suggested 10% guideline appears unrealistic within the general riding population. These data form the basis of assessment of the effect of rider physical measures on horse performance which will allow the development of a scientifically based guideline allowing informed decisions to be made on horse-rider suitability.

There are currently no industry-wide guidelines for the suitability of rider weight to horse size. Simple measures of rider weight can be used effectively to develop sensible rules upon which decisions about rider suitability for a particular horse can be made.

Positive and negative reinforcement: comparison of effectiveness and stress levels between inexperienced and experienced horses

Hendriksen, P.[1], Elmgreen, K.[1] and Ladewig, J.[2], [1]University of Copenhagen, Department of Biology, Universitetsparken 15, 2100 Copenhagen, Denmark, [2]University of Copenhagen, Department of Production Animals and Horses, Groennegaardsvej 8, 1870 Frederiksberg, Denmark; katrine.elmgreen@gmail.com

The traditional way to train horses is by application of negative reinforcement (NR). Today the use of positive reinforcement (PR) has become more common. To evaluate the effectiveness and stressor effect of NR and PR, two studies were conducted; one using horses with no training experience and one using experienced horses. In the study using inexperienced horses, 20 2-5 year old horses were trained to lead, stand and stay upon a hand signal in 10 sessions. In the study using experienced horses, 12 horses exhibiting trailer loading problems were exposed to trailer loading. Training was completed when the horse could enter the trailer upon a signal, or was terminated after maximally 15 sessions. In both studies the NR procedure consisted of various degrees of pressure (lead rope pulling, whip tapping). Pressure was removed when the horse complied. The PR procedure consisted of clicker training. Heart rate was recorded and behavior denoting discomfort was observed using one-zero sampling. In the study using inexperienced horses a Mann Whitney U test indicated that the NR group progressed further ($P=0.002$) and expressed more discomfort behavior (NR 8.52±5.76; PR 2.31±3.16, $P<0.001$) than the PR group. Generalized Linear Mixed Model analysis showed a decrease in the expression of discomfort behavior over time in the NR group ($P<0.05$), and an increase in the PR group ($P<0.05$). In the study using experienced horses a Mann Whitney U test indicated that the horses trained with NR displayed significantly more discomfort behavior (NR 13.26±3.25; PR 3.17±8.93, $P<0.0001$) and that the PR group spent less time (sec) per session to reach the training criterion (NR 672.9±247.12; PR 539.81±9.84, $P<0.01$). A Mann Whitney U test indicated that no difference was seen in heart rate (bpm) between groups (NR 53.06±11.73; PR 55.54±6.7, $P>0.05$). The results provide evidence that when training inexperienced horses, NR can be used with success concerning both effectiveness and stress level. When training experienced horses in a potentially stressful situation the PR procedure provides a more effective and less stressing solution. Hence care should be taken to both the mental state and the experience level of the horse prior to choosing a training method.

Positive (PR) and negative (NR) reinforcement refers to the addition (PR) or subtraction (NR) of a stimulus. The current studies suggest that in the training of inexperienced horses NR is the most successful procedure, whereas the PR procedure is more successful when training experienced horses in stressful situations.

A pilot study evaluating American Quarter Horse's behaviour compared to rider's aids when being shown in Equitation or Horsemanship classes

Peine, K.[1], Mclean, A.K.[1] and Wei, W.[2], [1]University of Wyoming, Animal Science, Dept 3684, 1000 E. University Ave, Laramie, WY 82071, USA, [2]Michigan State University, CANR Statistical Consulting Center, A366 PSSB Crop and Soil Science Building, East Lansing, MI, 48824, USA; kpeine@uwyo.edu

Equitation and Horsemanship classes are judged on how well the horse and rider can complete certain maneuvers together in harmony. This study attempts to score and quantify the horse's behavior based on the rider's use of aids and position. Equitation is ridden in English tack and attire and Horsemanship is ridden one-handed in western tack and attire. A total of 20 horses and riders randomly selected (Group A, Equitation, n= 10; Group B, Horsemanship, n=10) were video taped at 2010 American Quarter Horse Youth Association World Show, Oklahoma City, OK, USA. All riders were top riders (none poor) and qualified to compete at world show. Each pattern was scored by ten reviewers trained in judging horses and riders. Each horse and rider pattern was evaluated based on 13 questions. Signs recorded for horse-included position of nose, topline, stride of horse at trot and canter, expression in mouth, ears, tail and signs of disobedience (e.g. kicking out or bucking). The rider was evaluated based on upper body position in relationship to seat and legs, elbows according to hip and heels, heels related to seat and upper body, position of eyes, and percieved tension on reins. A significant difference was found ($P<0.1$) when comparing the two groups for expression of the horse's mouth ($P=0.003$), ears ($P=0.09$), and tail ($P=0.0001$) as well as rider's perceived tension on reins ($P=0.0001$). It was more likely that no abnormalities in mouth (e.g. gapping mouth/open, tongue out or chomping on the bit) were recorded in Group B where Group A was more likely to exhibit signs of an open mouth. The results suggested that Group B were more likely to have their ears set to the side compared to A. Group A was more likely to swish its tail when compared to B. When comparing percieved tension on reins between Group A and B the data was not evenly distributed. However, data for A suggested it was more likely to have some contact on their reins when compared to B. This study suggests that expression in the horse's mouth, ears and tail varies little when being ridden in Equitation or Horsemanship with top riders. More research is needed to determine if the position of the rider at different levels can create conflict behavior.

The study's data suggested that top youth riders caused little conflict behaviour in their horses when performing a required pattern which maybe related to how they more correctly used their aides when riding.

Quantification of standing balance in horse riders

Hobbs, S.J.[1], Broom, V.L.[1], Baxter, J.[1], Dagg, L.[2] and Alexander, J.[1], [1]University of Central Lancashire, Preston, PR1 2HE, United Kingdom, [2]Myerscough College, Bilsborrow, Preston, United Kingdom; sjhobbs1@uclan.ac.uk

Little is known about participation adaptations in the larger population of horse riders. The aims of this study were therefore to survey a population of horse riders to determine whether adaptations due to riding exist. This is part of a larger, ongoing study to quantify posture, flexibility and balance in horse riders. Thirty one right handed riders age 36±12 yrs, height 168±6 cm, weight 68±12 kg attending rider camps participated in standing balance, single leg static balance and a single leg reaching test. Centre of pressure excursion (COP) was recorded for 20 s at 50 Hz during each test using an RS Scan pressure mat on both, left and right legs. Reach distance in anterior, posterior, medial and lateral directions were tabulated as a ratio of leg length. Percentage weight bearing for each limb during standing was recorded. The difference in COP excursion, reach distance and a ratio of COP excursion to reach distance between right (R) and left (L) legs in each direction were calculated (symmetry = R – L). MANCOVA was used to test for significant differences in balance for years riding, dressage level and injured versus non-injured riders. Pearson correlations were used to investigate relationships between balance variables and covariates. Subjects who had spent more years riding were significantly ($P<0.05$) more stable on their right leg in the medio-lateral direction during single leg balance. Significant ($P<0.05$), but opposite relationships were found between years riding and single leg static balance symmetry ($r=-0.433$) and reaching balance symmetry ($r=0.395$). No other variables or covariates were significant. The results suggest static balance improves on the right leg compared to the left with horse riding, but the left leg is increasingly more stable during dynamic balance. Asymmetric movement patterns such as mounting compared to more symmetric posture during riding may explain these differences. Further work is required to corroborate these findings, particularly related to limb dominance, age, specific lower limb injuries and other potentially confounding factors.

Sports that use frequent asymmetrical loading and movement patterns have been found to develop left and right sides of the body differently. Horse riders may be symmetrical, but very little is known about the larger population of riders. So far, we have found greater stability in the right leg with years riding when standing on one leg, but greater stability in the left leg when reaching side to side. With further work we will learn more about adaptations due to riding.

Postural asymmetry of the rider whilst static and in sitting trot

Longhurst, K. and Mcdonald, K., Hartpury College, Animal & Land Science (Equine Science), Hartpury, Gloucester GL19 3BE, United Kingdom; kirsty.mcdonald@hartpury.ac.uk

Rider asymmetry is considered a potential performance limiting factor within the equestrian field, however the prevalence and manifestation has yet to be researched to a sufficient level to apply the findings more practically. The purpose of this study was to evaluate rider asymmetry during sitting trot by identifying discrepancies between bilateral joint angles. The study population consisted of fifteen female riders (age 18 to 22 years, 21.5±0.71, body mass 67±9.42 kg, height 169.9±5.5 cm) with competitive records in a range of disciplines who rode a minimum of five times weekly. Eight angles of the upper limbs, lower limbs and trunk were measured whilst static and during the highest and lowest point of the slow trot speed simulated stride cycle of a Racewood Riding Simulator to quantify positional asymmetry. Leg length discrepancies (LLD) were measured and correlated against angle discrepancies. Two cameras, perpendicularly situated to the mechanical horse, captured the static and dynamic footage and angular data was generated using Dartfish 5.5. Overall, the right side of the torso displayed a more vertical position ($P \leq 0.001$) and the right hand was positioned lower; in addition, the right upper arm absolute angle was greater ($P \leq 0.001$) indicating a closer positioning to the riders' torso than the left. During peak trot stride the right side absolute angles of the trunk ($P \leq 0.001$; L:85.6˚ R:90.5˚) and thigh ($P \leq 0.05$; L:46.5˚ R:49.5˚) increased to a more vertical position. The absolute angle of the lower left leg was significantly larger ($P \leq 0.05$) at the highest point of the trot stride (L: 72.4˚ R: 69˚) than when static (L:72.7˚ R:70˚) or at the low point of the trot (L:74.6˚ R:70.7˚), indicating a more forwards placed lower limb. The results indicate the left shoulder and hip were anteriorly rotated in relation to the right during peak vertical movement whilst the lower left leg is consistently further forwards. No significant correlations were observed between the asymmetry of joint angles and LLD ($P \geq 0.05$). Although not a variable for this study, rider handedness was recorded and all riders were right hand dominant; lateral dominance of the rider may therefore be an influencing factor.

The study suggests commonly asymmetrical postures may be adopted by riders; the degree and type of asymmetry appears to be exaggerated during motion. Typically, rotation of the torso occurs with the right side becoming more vertical during peak movement and the right upper arm positioning closer to the torso. The underlying causes require further research however these preliminary results can support recognition and correction of common rider asymmetries during training.

Effects of breaking, starting and training sessions on adrenocortical responses of Arab horses

Cravana, C., Medica, P., Fazio, E. and Ferlazzo, A., Unit Veterinary Physiology, Morphology, Biochemistry, Physiology and Animal Production, Polo Universitario Annunziata, 98168 Messina, Italy; kricra@libero.it

Breaking and starting represent critical phases of human-horse interaction. Aim of this study was to evaluate whether breaking, starting and training sessions had different effects on post-exercise circulating cortisol changes of eight healthy Arab horses (3 males, 5 females), 1-3 years old. Group I: (2 males, 2 female horses) submitted during two consecutive weeks on alternate days to breaking sessions, represented by 60 min exercise performed with rope on a round track (10 min walk, 10 min trot in a clockwise direction; 10 min walk, 10 min trot in an anti-clockwise direction; 10 min walk, 10 min trot in a clockwise direction). After a week, they were submitted during two consecutive weeks on alternate days to starting sessions, represented by 60 min exercise performed with rope and thorax belt, as described before. Group II: (1 male, 3 female saddled horses) submitted during two consecutive weeks to daily training sessions, represented by 60 min exercise performed with the same rider on a round track (10 min warm-up with rope, 10 min walk, 10 min trot, 5 min gallop, 10 min trot and gallop and 15 min winding-down exercises). Blood samples were drawn three times a week before and 5 and 30 minutes after sessions. Circulating cortisol levels were determined in duplicate using a commercially available immunoenzymatic kit supplied by RADIM (Pomezia, Italy). Statistical analysis were carried out by 1-way RM-ANOVA and Student's paired and unpaired t-test. Compared to basal, higher not significant cortisol levels were observed both at 5 (+7.00%) and 30 (+5.80%) min after breaking sessions; lower not significant cortisol levels were observed both at 5 (-10.80%) and 30 (-16.40%) min after the starting sessions; significant higher cortisol levels were observed both at 5 (+68.60%; $P<0.001$) and 30 (+139.40%; $P<0.001$) min after the training sessions. RM-ANOVA showed a significant effect of training on circulating cortisol changes ($F=96.67$; $P<0.0001$). No significant differences in basal values were observed. Circulating cortisol levels were significantly lower at 5 ($P<0.001$) and 30 ($P<0.005$) min after the breaking and starting sessions than after the training session. No significant differences were observed according to different age and gender.

Data showed that workload stress of breaking and starting sessions was the same, without significant changes on cortisol levels; the workload stress of training sessions resulted the highest, in according to daily exercise, with significant post-exercise increases of cortisol levels. The psychophysic reactivity during breaking and starting sessions was lower than during training sessions.

Developing research into horse-human relationship: a review

Birke, L.[1] and Hockenhull, J.[2], [1]University of Chester, Parkgate Road, Chester, United Kingdom, [2]University of Bristol, Langford, Bristol, BS40 5DU, United Kingdom; Jo.Hockenhull@bristol.ac.uk

Humans have considerable impact on horses, through the various ways we interact with them. Increasingly, these impacts have come under scientific scrutiny, and there have now been a number of studies examining how what humans do during riding or on the ground affect equine behaviour and welfare, as well as studies concerned with how horses in turn have an impact on human well-being and safety. Equitation science has an important part to play in analysing and documenting these interactions, and advancing our understanding of how horses learn during interactions with humans. There are still relatively few studies which focus on the relationship between horse and human, however. To date, many of these studies have predominantly focused their attention on one participant of the interaction, the horse or the human, rather than focusing on the relationship itself. Here we review the scientific studies that have been conducted in this area, and ask what has been learned from them about horse-human interactions. Consideration will then be given to the ways in which research in this area can be further developed. This should draw on scientific studies of equine behavioural responses to humans, but should also be based upon rigorous qualitative and sociological research. We will review such research, and illustrate using examples from our own collaborative research on the horse-human relationship, which brings together such different disciplinary approaches. In particular, we will argue for the importance of a multi-disciplinary approach, which can take into account both human and equine participation, and the wider social/cultural context. Furthering our understanding of horse-human interactions has implications for horse welfare and human safety. The relationship between horses and humans impacts on daily interactions during routine handling as well as on the working partnership. For the horse, the quality of their relationship with their owner may determine the longevity of their association, as owners with poor relationships with their horses may be more inclined to sell the horse on. Knowledge of what constitutes a good horse-human relationship will help us understand what happens when a relationship fails and how it may be restored.

This paper will review research investigating the human-horse relationship, looking at what scientific studies can contribute. We will also stress the importance of other approaches – such as human sociology, for example – and consider what they can contribute. A better understanding of how relationships develop between horses and people matters for both human safety and for equine welfare.

Effect of discipline (Western vs Dressage) and skill level on learning and discomfort behaviour of riding horses

König V. Borstel, U., Kassebaum, L. and Gauly, M., University of Göttingen, Animal Science, Albrecht-T.W. 3, 37075 Göttingen, Germany; koenigvb@gwdg.de

The hypothesis of the present study was that Western ridden horses would show faster learning of the same riding tasks and less discomfort behaviour compared to the English (i.e. Dressage) ridden horses because of the better consideration of learning theory. For example, the complete removal of rein pressure, as desired in Western, but not Dressage riding, when the horse gives the correct response to a rein aid implies a more distinct and likely more consistent application of negative reinforcement and should thus make it easier for the horse to learn the desired response. Twenty-four horses either trained in Dressage riding (n=13) or in Western riding (n=11) of various breeds and skill levels (both attempted to be balanced across disciplines) were ridden by their riders. They rode a pattern involving elements both from Western (mainly trail) and Dressage riding, such as transitions between gaits, riding through a gate and slalom. Each pair was then given 20 min to train the pattern according to their own concept, after which the pattern was repeated. Both in the first and second ride of the pattern, performance was scored by a riding-style independent judge, and we measured time for completion and departure of hoofprints from the ideal path for individual tasks to obtain objective measurements for the accuracy of tasks. In addition, we measured heart rates, rein tension, and behaviour of the horses. Mixed model analysis revealed that in a number of tasks, improvements from first to second rides could be seen, as measured by an increase in scores and a reduction of aversive behaviour patterns: for example, there was less head-tossing during the 2nd (0.02±0.04 occurrences per task) compared to the 1st (0.12±0.04) ride. Also, depending on the type of task, scores were either higher with the Western trained horses (e.g. transport of an item: 6.6±0.3 vs 5.9±0.3 out of a maximum of 10) or with Dressage trained horses (e.g. stop: 5.7± 0.2 vs 4.9±0.2). However, overall there were no significant differences (P>0.1) in scores, deviation from the ideal path, heart rate or discomfort behaviour between Western and Dressage horses. In contrast to the effect of discipline, horse-rider pair skill level was highly significant for many parameters, for example with fewer resistance against the hand (-0.3±0.11 occurrences per task), less rein tension (-365±158 g (Dressage horses only)) and higher scores for overall performance (Western: +0.6±0.2; Dressage: +0.4±0.1) per increasing skill level.

Horse-rider-pair skill level rather than differences between Western and Dressage riding styles has the predominant impact on horse’s performance, learning and discomfort behaviour during riding.

Investigation of the effect of balancing aids on the skin temperature of the ridden horse

Allin, K.[1], Stacey, E.[2] and Randle, H.[1], [1]Duchy College, Equitation Science, Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom, [2]Inside Imaging Ltd, Brent Knoll, Highbridge, Somerset, TA9 4BE, United Kingdom; julian.katie@sky.com

Neck straps and saddle handles are used to aid rider balance and may have a negative impact on the tissue that they are in direct contact with, however objective data on the physical effect of balancing aids on the ridden horse are not available. This study aimed to identify skin temperature deviations using Infrared Thermal Imaging (ITI). Research has shown that temperature deviations, both increases and decreases, can be indicative of tissue damage. Four ponies (2 mares, 2 geldings), aged 9-15 years who regularly engage in Pony Club activities were assessed. All were tested wearing their usual bridle, the same girth, neck strap and saddle with integrated saddle handle and were ridden by a competent 12 year old male. A FLIR P620 thermal imaging camera was used to generate thermographic maps for each pony. The temperature (^{o}C) for specific anatomical locations (for neck strap – withers, both shoulders and neck base; for saddle handles – girth, cantle, under the saddle and under the both saddle ring points) was then determined following warm up, post exercise (without balancing aids) and post-use of the balancing aid phases. Each phase followed a set route, with walk and trot and lasted for 10 minutes. Skin temperatures were not affected by the phase of the study for either neck straps or saddle handles. However skin temperature varied significantly between measurement positions ($F_{3,132}$=3.83; P<0.01), with significantly higher temperatures observed at the neck base (24.4±3.06^{o}C) than at the shoulders and withers (Tukeys P<0.05) when neck straps were used to assist balance. In addition skin temperatures observed at the withers were significantly lower (22.15±3.09^{o}C; P<0.05) than those evidence in all other positions when a neck strap was used. The skin temperatures observed following the use of a saddle handle also varied between measurement positions ($F_{4,165}$=46.91; P<0.001). Skin temperature was significantly lower (P<0.05) at the under saddle position (13.9±1.88^{o}C) than at the cantle, girth, and either of the ring point positions (21.9±3.3^{o}C; 22.6±4.21^{o}C; 21.2±3.05^{o}C and 21.4±2.93^{o}C respectively when a saddle handle was used. ITI has demonstrated that the use of balancing aids can have a physical effect on the horse/pony with irregular temperatures observed where the balancing aids interface with the horse.

Those responsible for the welfare of the ridden equid should be aware of the physical impact that the use of balancing aids may have. Dependency on balancing aids could be avoided by training novice riders balance techniques prior to riding.

A review of early exercise in the horse

Rogers, C.W.[1], Van Weeren, P.R.[3], Firth, E.C.[1], Bolwell, C.F.[1] and Tanner, J.C.[1], [1]Massey University, Massey Equine, Institute of Veterinary, Animal and Biomedical Sciences, Private Bag 11222, Palmerston North 4442, New Zealand, [2]Utrecht University, Department of Equine Sciences, Faculty of Veterinary Medicine, Yalelaan 102,, Utrecht, Netherlands; c.w.rogers@massey.ac.nz

Across all equestrian disciplines the single largest reason for wastage is musculoskeletal injury. It is therefore important that management and competition structures are in place to optimise the development of the equine musculoskeletal system to minimise wastage. Data from other species and humans in particular, has demonstrated the benefit of early exercise and the consequences of inactivity. The horse has evolved as a cursorial animal capable of covering up to 10 km / day within 9 days of birth. Yet modern equine management systems restrict rather than promote early exercise. Warmblood foals had a positive response to early pre weaning paddock exercise and more recent work has demonstrated that exercise over and above that normally occurring with pasture reared foals had positive effects on the equine musculoskeletal system. The response of juvenile horses to additional exercise is due to the tissue being responsive to priming. However, epidemiological data indicates that the window for tissue modification may still be open when the horse is a yearling and even as a 2-year-old. A historical cohort study of both Thoroughbred and Standardbred horses demonstrated that the horses that entered training as 2-year-olds had longer and more successful racing careers than those that entered training later in life. It would appear that even the initial stages of training are enough to provide a positive stimuli as horses first registered with a trainer at 2 years-old had similar advantages as those that raced as 2-year-olds. The physiological, clinical and epidemiological data indicates that rather than restrict exercise and the use of horses at a young age we should realign expectations with the capability of the horses musculoskeletal system and evolutionary template to maximise orthopaedic health.

Across all equestrian disciplines the single largest reason for the loss of horses and lost training days (wastage) is musculoskeletal injury. Providing management and competition structures that promote early exercise would permit priming of the equine musculoskeletal system, greater orthopaedic health, less wastage and improved horse welfare

Two estimates of consistency in judging dressage competitions

Stachurska, A.[1] and Bartyzel, K.[2], [1]University of Life Sciences in Lublin, Department of Horse Breeding and Use, Akademicka 13, 20-950 Lublin, Poland, [2]The John Paul II Catholic University of Lublin, Department of Computer Image Analysis, Al. Racławickie 14, 20-950 Lublin, Poland; anna.stachurska@up.lublin.pl

Dressage scores may be used in horse breeding and equine science analyses on condition the judging is reliable. High quality of judging is important also in the sport. The objective of the study was to improve methods assessing the judging in the dressage discipline. Grand Prix, Grand Prix Special and Grand Prix Freestyle classes run at the Olympic Games in Athens 2004 and in Beijing (held in Hong Kong) 2008 were analyzed. Fourteen judges in total were involved in the juries. The data included 30 055 marks for single movements presented during 174 horse entries. The accuracy of the judging was estimated with the improved Index of Disagreement (ID). The ID compares horse ranking in a movement, determined by a judge, to the ranking resulted from marks awarded by other four members of the jury. Consistency of rankings at top places weighs more than further places. The Horse Mean Placing Standard Deviation (HMPSD) was developed to test the consistency in judging particular horses which participated at minimum three classes. The IDs (between Athens vs. Hong Kong, between individual judges and between movements) and HMPSDs (in groups of horses classified according to Horse Mean Placing) were compared with non-parametric Kruskal-Wallis significance test. The analysis indicates that the horse scores in the dressage even at the Olympic Games were not quite reliable. The ID at the Olympic Games in Hong Kong (19.8±7.9%) was higher than in Athens (17.8±7.9%; $P<0.01$). The average ID for individual judges was considerably differentiated (14.9-22.1%; $P<0.01$). In Grand Prix and Grand Prix Special, assessment in some movements assumed to be rather easy for horses (e.g. proceed in canter to the right, proceed in canter to the left and single flying change of leg), was less consistent than in other movements regarded to be difficult. Horses ranked at top five placings were assessed four times more consistently than horses placed further.

The modified Index of Disagreement is suggested to: (1) process the dressage competition scores in the view of accuracy, (2) classify judges with regard to the consistency in judging with others. The method may be adapted to train the judges by comparing their rankings to model rankings determined by an authority. The Horse Mean Placing Standard Deviation enables to check if a horse is judged consistently.

The impact of maternal equine appeasing pheromone on cardiac parameters during a cognitive test in saddle horses after transport

Cozzi, A., Lafont Lecuelle, C., Monneret, P., Articlaux, F., Bougrat, L., Bienboire Frosini, C. and Pageat, P., IRSEA Research Institute, Le Rieu Neuf, 84490, Saint Saturnin Les Apt, France; a.cozzi@irsea.info

Stress is known to affect cognitive processes in most species. Transport is one of the most common stressing events in horses and impairs their performances. The purpose of this study is to assess the impact of a semiochemical, released by lactating mares, EAP (Equine Maternal Pheromone), to control this stress and maintain cognitive capabilities during a standardized test. 23 horses from different breeds, between 2 and 20 years old, were divided in two homogeneous groups; by sex, age and transport experience; horses were included in a double blinded, randomized, two parallel groups study (EAP vs placebo). The treatment was applied 20 minutes before each transport. Every horse was transported on a standardized 60-km roundtrip. The cognitive assessment was divided into three sessions: learning and memorization (during these sessions, horses were trained to differentiate two geometric figures: a yellow circle and a blue triangle, to get carrots) before transport and reversal (if horses learned to receive carrots in the yellow circle, in the reversal session they obtained the reward only if they touched the blue triangle) after transport. Emotional variations were evaluated thanks to cardiac parameters during the reversal session: cardiac parameters were measured through Heart Rate Variability (HRV). The placebo and EAP groups were compared using the two-sample Student t test. We found significant differences between the two groups with regard to Heart Rate: (EAP: 56.36±7.63 bpm; placebo: 64.48±9.37 bpm; df=21; t=2.27; P=0.03). We found no significant differences between the two groups for the mean square root for differences in successive RR intervals (RMSSD) (RMSSD: EAP: 66.71±32.66 ms; placebo: 55.42±46.82 ms; df=21; t=-0.66; P=0.51) and also for Low Frequency/High Frequency even if the ratio is higher in the placebo group (LF/HF: EAP: 6.21±8.48%; placebo: 7.18±8.81%; df=21; t=0.27; P=0.79).

Results show the impact of EAP on cardiac parameters during a cognitive test after a stressful situation (transport). The present study highlights the interest in using and investigating the semiochemical approach to facilitate horses' adaptation process during a cognitive effort. It is interesting to assess physiological changes in horses during a standardized test such as this one: it is crucial to consider this change during cognitive processes in order to manage and to better understand the emotional state of an animal.

Towards a welfare monitoring system for horses in the Netherlands: prevalence of several health matters

Neijenhuis, F.[1], De Graaf-Roelfsema, E.[2], Wesselink, H.G.M.[3], Van Reenen, C.G.[1] and Visser, E.K.[1],
[1]Wageningen UR, Livestock Research, PO box 65, 8200 AB Lelystad, Netherlands, [2]Utrecht University, Faculty of Veterinary Medicine, Department of Equine Sciences, Yalelaan 114, 3584 CM Utrecht, Netherlands, [3]Independent Veterinary Professional, Beerzerweg 11, 7736 PH Beerze, Netherlands; francesca.neijenhuis@wur.nl

The assessment of welfare is a multi-disciplinary process, including assessment of behaviour and health. Following the Welfare Quality® (WQ) framework, a welfare monitoring system for horses is being developed in the Netherlands. The system focuses on animal- rather than environment-based parameters. With the use of protocols for recording horses' health, 150 horse farms voluntarily participated in this study. On each farm 20 horses were clinically examined, in total almost 3000 horses. This study revealed that 80.7% of the horses showed a normal gait and 4.8% were moderate to severe lame. Following palpation of the back, 68.9% of the horses were found to have no signs of a sensitive back and 8.4% showed a severely sensitive back. In 96.6% of the horses no irregularities were found in the gums, whereas 3.4% had wounds or hard spots. Likewise, 81.5% of the horses had no irregularities in the corners of the mouth, and 18.5% had wounds or hard spots. Risk factor analysis (mixed model with logistic regression) demonstrated that older horses (>18 yr) compared to young ones (<4 yr) were more ($P<0.001$), and horses used in competition compared to animals out of competition were less ($P<0.001$) prone to show gait deficits/lamenesses. Furthermore, sensitivity of the back was most prevalent in horses used for riding lessons, followed by horses used for recreation, competition and breeding ($P<0.001$). Relative to other horses, horses used for riding lessons had more irregularities in the corners of the mouth ($P=0.025$). The current study focuses on prevalence's, and does not incorporate interpretation of (negative) results. For the development of a valid welfare monitoring system according to the WQ approach, further research steps are necessary, including the establishment of the relative importance of individual welfare measures and the assessment of threshold values.

A welfare monitoring system for horses may be a valuable tool for horse owners to improve horse welfare and to benchmark horse farms. Therefore, a welfare monitoring system, with a focus on health and behaviour, is being developed. In a first study, 150 horse farms, approximating 3000 horses, have been assessed. Further study is warranted to interpret current and future prevalence's of health and behaviour problems.

Comparison of heartrate, lactate and velocity between training and competition in 3- to 4-star eventing horses

Baumann, J.[1], Düe, M.[2], Holzhausen, H.[3], Leinker, S.[1], Martens, S.[1] and Weddige, I.[1], [1]German Olympique Committee for Equestrian Sports, Freiherr-von-Langen-Straße 15, 48231 Warendorf, Germany, [2]German Equestrian Federation, Freiherr-von-Langen-Straße 15, 48231 Warendorf, Germany, [3]Olympique Sports Centre Warendorf, Dr. Rau-Allee 32, 48231 Warendorf, Germany; smartens@fn-dokr.de

Purpose of the study is evaluation of training in high class eventing horses compared to demands during competition. In 2008 24 horses (8-17 yrs; Ø11.9±2.5 yrs) of the German eventing team were tested during 6 competitions. 11 of these horses were also tested during gallop interval trainings. In standardized training protocols every training session of 7 of these horses was recorded between Mar and Aug (7-24 wks). Velocity (v) and heartrate (HR) were measured by GPS-device including HR-receiver (EquiPILOT S-2000) and HR-transmitter (Polar WearLink Coded combined with Polar Girth T54H). Blood taken from jugular vein was analyzed for lactate (LP 20 Dr. Lange) 10 minutes past gallop training and cross country. Statistic was done with Mann-Whitney-U-Test. All measured parameters were significant lower ($P<0.01$) in training than in competition. During sprinting in gallop training average v was 487±73 m/min (n=18) and average v_{max} 656±75 m/min (n=20). Average v during competition was 535±24 m/min (n=43) while average v_{max} was 767±75 m/min (n=28). HR during gallop training sessions was average 106±11 bpm (n=13) while during competition average 197±13 bpm (n=23). HR_{max} was 208±23 bpm (n=13) at gallop training compared to 229±10 bpm (n=25) at competition. Lactate concentration was 7.5±7.0 mmol/l (n=22) after training and 14.4±7.3 mmol/l (n=55) after competition. All together 1319 training sessions including paddock (29%) and horse walker (9%) have been evaluated. The riders spent most of their sessions with training dressage (24%) followed by walk under the saddle (7%). 5% of their training sessions, respectively, implied jumping training, longing and hacking. Only 4% of the evaluated training sessions were spent on gallop training. Training of eventing horses is focused on technical training. Conditional training has less value. A comparison of velocity, lactate and heartrate between gallop training and competition leads to the conclusion that the demands in the tested horse are higher in competitions than in their gallop training sessions. Compared to other sports there seems to be no adequate training stimulus with regards to the training of the tested eventing horses. Also a classical periodization of training to optimize performance wasn't visible.

Comparison of heartrate, lactate and velocity in 24 high class eventing horses show that the demands in competitions were higher than in gallop training. Evaluation of standardized training protocols demonstrated that training was focused on technical training.

Objective detection of locomotion asymmetry using a 3D inertial sensor gait analyses-system in sound horses

Hardeman, L.C.[1], Van Der Meij, B.R.[1], Wijnberg, I.D.[1], Van Dierendonck, M.[2], Van Der Kolk, J.H.[1] and Back, W.[1,3], [1]Utrecht University, Equine Sciences, Yalelaan 114, 3584 CM Utrecht, Netherlands, [2]Utrecht University, Behavioural Biology Group, Padualaan 8, 3584 TB Utrecht, Netherlands, [3]Ghent University, Surgery and Anesthesiology Domestic Animals, Salisburylaan 133, 9820 Merelbeke, Belgium; L.C.Hardeman@uu.nl

During lameness examinations usually different gaits, surfaces and directions are chosen. It is not known, however, how these variables influence the locomotion pattern of a sound horse. Today's mobile gait analysis systems enable us to objectively record the segmental and coronal angles. The aim of this study was to measure the normal equine locomotion pattern using a 3D inertial sensor system enabling measurement of the symmetry of the movements in different gaits on different surfaces. The locomotion pattern of seven warm blood horses was measured using the Pegasus Stride System®. All horses followed a standard protocol consisting of a warm-up, walk and trot at hand on straight lines and walk and trot on the lunge on clockwise and anticlockwise circles on hard and soft surface. A possible motor laterality preference was tested in a stance preference test (PT). The segmental and coronal angles of the left and right limb were compared using a paired T-test ($P<0.05$, R-statistics®). It appeared that the segment angles of the right forelimb at walk on the clockwise circle were significantly larger than those of the left forelimb. In the hindlimbs at walk and trot on a circle the segmental angles of the outside limb were significantly larger than those of the inside limb. The coronal angles of the outside forelimb at walk and trot on a circle were significantly larger than those of the inside forelimb whereas the coronal angles of the hindlimbs were not significantly different. The PT showed a significant ($P<0.05$) left laterality of two horses and overall a significant left preference. The significant forelimb asymmetry on the circles might be due to the horse's laterality. Left laterality, like in the studied group, might facilitate bending to the left and thus reduce the segmental angle of the inside limb on the anticlockwise circle but on the contrary increases that of the inside forelimb on the clockwise circle. The asymmetrical, circular movement enforced on the horse's limb might result in larger segmental angles on the outside hindlimbs and larger coronal angles of the outside forelimbs.

In sound horses the locomotion pattern is influenced by the movement direction becoming asymmetrical on a circle. Additionally the absolute segmental and coronal angles seem to be influenced by the laterality of the horse, this phenomenon is more apparent on a circle. The causality is still to be examined.

Quantifying stress in experienced and inexperienced mounted police horses, using heart rate, heart rate variability, behaviour score and suitability score

Munsters, C.[1,2], Visser, K.[3], Van Den Broek, J.[4] and Sloet Van Oldruitenborgh-Oosterbaan, M.M.[1], [1]Utrecht University, Equine Sciences, Faculty of Veterinary Medicine, Utrecht, Netherlands, [2]Moxie, Sport Analysis & Coaching, Erp, Netherlands, [3]Wageningen University, Livestock Research, Lelystad, Netherlands, [4]Utrecht University, Farm Animal Health, Utrecht, Netherlands; carolien@munsters.nl

Mounted police horses have to cope with challenging and unpredictable situations during their duty and it is essential to select suitable horses for this purpose. The aim of the study was to evaluate stress and to assess the future capability (FC) of twelve mounted police horses; six experienced (19-120 months of experience) and six inexperienced (<1 month). The ordinary, qualitative suitability assessment (suitability responses [SR]) of police trainers were compared with quantitative assessments of heart rate (HR; beats/min), heart rate variability (HRV; in RMSSD [ms]) and behavioural score (BS; between 0=completely relaxed to 5=very anxious) in four challenging object tests (Test-I: indoor arena test, Test-II: outdoor test, Test-III: street test and Test-IV: smoke test). All tests were repeated in week 1, week 3 and week 7. All data (mean±sd) were statistically evaluated using a linear-mixed-model-test (Akaike's Information criterion; t>2.00). Horses undertaking the outdoor test (HR=80±20, HRV=55±57) and the street test (HR=81±14, HRV=86±94) had no more stress than during normal riding (HR=82±20, HRV=33±33). In contrast, the indoor arena test (HR=98±26, HRV=42±50,) and smoke test (HR=107±25) caused significantly more stress (resp. t=2.44; t=-2.78 and t=3.50) than normal riding or the street test. The FC of mounted police horses could, however, not be predicted with these tests. No significant habituation occurred: although horses tended to habituate during the first two weeks, after a four week interval the outcome was comparable with the first week. There were no significant differences in any of the four tests between the HR, HRV, SR and BS between experienced and inexperienced horses. This indicates that experience is not the key factor in how police horses handle stress. It was interesting to find that there were no significant differences in BS of the individual horses undergoing these tests. It was speculated that horses preselected to become mounted police horses were already habituated to frightening stimuli to some extent and hence showed fewer adverse behavioural responses. HR of horses was not correlated with their observed behavioural responses.

This study suggests that stress and therefore the physiological and psychological state of a horse is not always reflected in its behaviour. HR and HRV seemed to be the more valuable parameters to assess stress in a horse.

The effect of noseband tightness on rein tension in the ridden horse

Randle, H.[1] and Mcgreevy, P.[2], [1]Duchy College, Equitation Science, Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom, [2]University of Sydney, Faculty of Veterinary Science, Gunn Building, University of Sydney, NSW 2006, Australia; hayley.randle@duchy.ac.uk

Many horses wear nosebands designed to restrict jaw movement, an attractive outcome in competitions where resistance is penalised. It has been suggested that a restrictive noseband may increase sensitivity to the bit. Despite the growing popularity of restrictive nosebands, no objective data are available on their effects, if any, on apparent bit sensitivity. This study aimed to determine if noseband tightness influences rein tension. A cross-over design determined the rein tension applied by a single rider to achieve a pre-defined medium contact with the noseband fitted in the normal, looser (one hole down from normal) and tighter (one hole up from normal) position. All horses were tested wearing their regular tack with a cavesson noseband and a simple snaffle bit. A nose net was used to screen the horse's muzzle and effectively blind the rider from the changes being made to noseband fitting. Six geldings aged 9-18 years were ridden through a standardised route around a 20x40 m indoor school. The route comprised 7 phases, including 4 transitions (halt-to-walk, walking, walk-to-trot, trotting, trot-to-walk, walking and walk-to-halt). There were 3 replicates per rein. The Rein Check™ was used to record rein tension (N) 100 samples/s during all observation periods which were simultaneously videoed. Noseband hole number, distance between the holes (mm), length (mm) and taper angle (^{o}, as a measure of the tightness of the noseband on the horse's face) were recorded. The rein tension data collated by SignalScribe™ was non-parametrically distributed with a median rein tension applied of 2.56N. Equal tensions were applied to the left and right rein throughout the study (left = 2.55N, right = 2.57N; H_1=0.67; P>0.05). Rein tension (N) was significantly affected by noseband tightness (H_2=16.7; P<0.0001). Although less tension was applied when the noseband was tightened by one hole (median=2.52N) the difference failed to reach significance (Mann-Whitney; P>0.05). However, significantly more tension was applied when the noseband was loosened by one hole (median = 2.63N; W=36102618; P<0.005). The use of equitation science and technology has demonstrated using objective data that there is some truth in the statement that noseband tightness may influence sensitivity to the bit.

This study demonstrated that noseband tightness has an effect on rein tension applied to a ridden horse in order to achieve a medium contact. Careful consideration must be given to the fitting of nosebands to horses and in particular riders' use of noseband tightness as a means to achieve a required outcome in equitation.

The effects of training on equines' loading behaviour

Pohjola, J.M., Sparsholt College Hampshire, Applied animal behaviour science, Westley Lane, Sparsholt, Hampshire SO21 2NF, United Kingdom; jaanapohjola@gmail.com

Loading situations are potentially dangerous for horses and for humans. Aversive stimuli may increase the horse's discomfort and increase the amount of resistant behaviour. Positive reinforcement training (PRT) techniques have been stated as useful training tools in animal training; with PRT the animals usually become more cooperative and exhibit less fear reactions. PRT could be more effective than negative reinforcement training, which is normally used in equine training. The aim of the study was to examine the possible effects of PRT on equines' loading behaviour. 24 horses in total were divided into three groups, with 8 horses in each group (A, B & C). Polar Equine heart rate belt was used together with a Garmin Forerunner 310XT GPS-watch to record the data. Group A and group B horses took loading tests untrained in which their heart rates, loading behaviours and total loading times were recorded. Group B and C horses went through a PRT programme during which they were clicker-trained to walk and reverse on and under trailer-resembling objects. The horses were taught to walk on a wooden plate, walk up and down the ramp and under a canopy with a tarp on it. After finishing the training programme, the horses in group B and C took additional loading tests with the same data being recorded. It was discovered that the trained horses load quicker. The average loading time decreased by 40% in group B (n=8) horses after the training programme. Fear-related behaviours and resistant behaviours were 17% lower in trained horses (n=16) and the average heart rates and peak heart rates were significantly lower in the trained horses than in the non-trained horses (n=16) (P=0.01; two-sample T-test). The peak heart rates were 25% lower in the trained horses and the average heart rates were 24% lower in the trained horses (n=16).

Training horses to voluntarily load with the use of positive reinforcement training and trailer-resembling structures can be beneficial in the equine industry. The potential advantages of PRT have not been fully exploited. Effective ways of training result in reduced stress reactions and it may also lead to enhanced welfare and handler safety. Potential implications of PRT could be useful in those husbandry procedures that normally cause fear and discomfort to horses.

Over-ground comparison of fore and hind limb fetlock extension and hoof slide

Walker, V.A.[1], Tranquille, C.[1], Brandham, J.[2] and Murray, R.C.[1], [1]Animal Health Trust, Centre for Equine Studies, Lanwades Park, Kentford, Newmarket, CB8 7UU, United Kingdom, [2]College of West Anglia, Equine Department, Landbeach Rd, Milton, Cambridge, CB24 6DB, United Kingdom; vicky.walker@aht.org.uk

The kinematics of the distal limbs have been described in many treadmill studies, but there is little information about over-ground locomotion on an arena surface in sports horses. It is assumed, based on treadmill findings, that kinematics of the fore and hind limbs are closely related, but this has yet to be confirmed in over-ground locomotion. Use of a treadmill can affect aspects of locomotion, so over-ground evaluation is more directly relevant to the ridden horse. The aim of the study was to determine if maximal fetlock extension and hoof slide of the ipsilateral fore and hind limbs are related and therefore if determination in one limb can predict the kinematic pattern of the ipsilateral limb. It was hypothesised that there would be a strong correlation in maximal fetlock extension and hoof slide between the fore and hindlimbs. Eight horses were fitted with reflective markers and ridden at working trot by the same rider in a straight line on a single surface. High speed video captured 16 strides for each horse on the left rein. Maximal fetlock extension, representing peak loading, and hoof slide, representing hoof deceleration, during stance were determined for the left forelimb and hindlimb. Data were plotted and linear regression performed to test for correlation between limbs. There was no significant statistical correlation between the maximal fetlock extension between the fore and hind limbs (R^2 <0.29; P>0.05). Hoof slide results demonstrated no significant correlation in 3 horses (R^2 <0.05; P>0.05) and a significant weak to moderate correlation in 5 horses (R^2 0.25-0.58; P<0.05) between the ipsilateral limbs. These findings suggest maximal fetlock extension and hoof slide of ipsilateral fore and hindlimbs do not have a close relationship during over ground locomotion. Independent forelimb/hindlimb loading and hoof deceleration indicate that external factors could affect fore and hind limb kinematics in different ways. When evaluating distal limb loading over ground, it is advisable to consider each limb separately as alterations within the fore or hindlimb do not indicate a corresponding response in the ipsilateral limb.

The pattern of movement of the forelimbs and hindlimbs during over ground locomotion appears to be poorly related, suggesting factors that alter the loading and deceleration, may not have equal effect on fore and hind limbs on the same side of the horse.

The effect of collection and extension on tarsal flexion and fetlock extension at trot

Walker, V.A., Walters, J.M., Griffiths, L. and Murray, R.C., Animal Health Trust, Centre for Equine Studies, Lanwades Park, Kentford, Newmarket, CB8 7UU, United Kingdom; vicky.walker@aht.org.uk

It has been recognised that young horses prepared for dressage horse sales, where they are presented with extravagant extended trots, have a high incidence of suspensory ligament (SL) damage. It was hypothesised that extended trot would be associated with gait characteristics that could predispose to SL injury. The aim of the study was to compare hindlimb movement patterns between collected and extended trot. Four dressage horses were fitted with reflective markers and inertial motion sensors (IMS). High speed video was obtained for two strides on each rein in collected and extended trot on 3 different surfaces: Surface 1) waxed outdoor. Surface 2) sand/plastic granules, Surface 3) waxed indoor. Maximal tarsal flexion during stance and distal metatarsal coronary band ratio (MTCR) representing fetlock extension, were determined. IMS data determined stride duration (SD), speed (Sp) and stride length (sl). Data was compared between collected and extended paces within each horse on each surface, and compared between surfaces using ANOVA procedures. Collected trot had significantly lower speed and stride length but longer stride duration than extended trot on all surface types (Horse1-3: $P<0.0001$; Horse 4: Surface 1:SD 0.0106, Sp 0.0245; Surface 3 Sp 0.0039, sl 0.0240). All horses had less tarsal flexion and MTPJ extension in collected compared to extended trot. Greater tarsal flexion combined with greater fetlock extension was observed in extended compared to collected trot, which is likely to increase SL loading. The study findings therefore indicate that extended trot may increase SL strain, providing a possible explanation for the high incidence of SL in horses trained for extravagant movement. It is possible this may be a particular risk for horses without good muscle development to support the limb. Considerable use of extended trot might be a risk factor for development of suspensory desmitis and could explain prevalence of proximal suspensory desmitis in successful young horses pushed for extravagant movement or those who are prepared for sales.

The findings of this study suggest that the extended trot produces greater loading and therefore a greater risk of SL injury than the collected trot. For this reason it is recommended that horses spend limited time in extended trot, to reduce the risk of SL injury.

The use of objective evaluation of the locomotor performance of Friesian horses

Voskamp, J.P.[1], Van Dierendonck, M.[2], Houterman, F.[3], Hellinga, I.[3] and Back, W.[1,4], [1]Utrecht University, Department of Equine Sciences, Yalelaan 114, 3854 CM Utrecht, Netherlands, [2]Utrecht University, Behavioural Biology group, P.O. Box 80086, 3508TB Utrecht, Netherlands, [3]Koninklijke Vereniging Het Friesch Paarden-Stamboek, Oprijlaan 1, 9205 BZ Drachten, Netherlands, [4]Ghent University, Department of Surgery&Anaesthesiology Domestic Animals, Salisburylaan 133, Merelbeke, Belgium; info@rosmark.nl

Aim To date Friesian horses show an increased popularity not only for showing purposes, but also for dressage sports. Thus, there is need to fully understand the locomotor characteristics of the Friesian horse. Therefore, the temporal relationships between limb cycles of a group of Friesian horses was investigated and objective locomotor variables were correlated to the scores of official studbook judges. Materials and methods Twelve sound Friesian horses (mean age±SD 4.3±1.8 years) were equipped with inertial movement sensors (IMS) housed in adapted brushing boots on the distal metacarpal/tarsal region of each limb. Judging of horses was done by a professional judge using a scoring system for conformational and gait traits. The evaluated conformation and gait traits had a maximum score of 10. Trials were conducted for walk and trot in hand and for canter free moving in a riding arena. Cross-correlation of the rotation velocity around the lateromedial axis of the IMS, on a stride by stride basis, was used to calculate temporal phase-lag between respective limb cycles. Phase-lag was expressed as a percentage of the stride duration of a reference limb for each limb. Pearson correlation coefficients were calculated to correlate the judged score with the IMS-measured locomotor variables ('r', $P<0.05$). Results The stride duration (mean±SD) at walk in hand was 1.13s±0.08s, at trot in hand 0.73s±0.04s and canter free moving in left canter 0.54s±0.04s and in right canter 0.55s±0.04s (n=12). The gait scores of the judge for the walk was 6.0 ±1.1, for the trot 6.6±1.0 and for the free canter 6.1±0.8. IMS-measured variables significantly correlated with judge scores for walk and trot. For walk the range of motion (degrees) of the hindlimbs ($r=0.80$, $P<0.05$) and the phasing ($r=0.74$, $P<0.05$) of the forelimbs, for trot the diagonal advanced placement ($r=0{,}69$, $P<0.05$) and the combined parameter of the range of motion of the hind limbs, stride length and stride duration ($r=0.87$, $P<0.05$), significantly explained the judge score. There was no significant correlation between the judge score and IMS-measured variables at canter.

The IMS equipment proved to be a reliable system to objectively measure the quality of the locomotor performance of Friesian horses. Objective evaluation of gait using these mobile systems may have the potential, to assist the jury in finding useful variables for early selection of Friesian horses.

A preliminary study into quantitative analysis of self carriage in dressage training

White, C. and Dilliott, J., Nottingham Trent University, School of Animal, Rural and Environmental Sciences, Brackenhurst Campus, Southwell, Nottinghamshire NG25 0QF, United Kingdom; cassie.white@ntu.ac.uk

In any competitive sport, the measure for success is to achieve a top level performance. The fastest time, longest distance and final scores are used to decide winners but sports which determine the victor through subjective means (i.e figure skating, gymnastics and dressage) remain areas of debate. Some attempts have been made to compare dressage judges scores with gait parameters however, the role of objective analysis for applied training purposes remains largely understudied. The aim of this study was to develop a method to quantitatively measure self-carriage of horses during a selected dressage movement using Pegasus Limb phasing system (ETB Ltd.) Nine horses performed the British Dressage Novice 24 test, (2002) ridden and judged as per competition regulations and data for Movements 7 and 14 'give and retake the reins over X in working canter' were analysed. British Dressage defines this selected movement as a test of self-carriage where the horse should maintain balance and rhythm. Rhythm is defined as a temporal measurement of footfalls and the intervals between. In order to test this objectively, three variables; speed(m/s), stride length(m) and stride duration(s) were measured and using the Pegasus GPS system to identify geographical location, the data was sectioned into three key stages of the movement; the initial strides of the movement from a set marker towards X, the phase of the movement over X and the following strides to the completion of the movement. Statistical analysis was carried out using a One Way Anova and post-hoc Bonferroni test and significant differences in stride duration ($P=0.013$) between phases of the movement were found. When analysed individually, some subjects maintained stride duration ($P>0.05$) but others did not. On review of judges' comments, these differences were also identified and commented on. Interestingly however, in a number of cases where stride duration was seen to be maintained, significant differences in speed ($P<0.001$) between the initial stage of the movement and last stage were seen and significant differences in stride length ($P<0.001$) between all stages of the movement were identified. This suggests changes in tempo rather than rhythm occurred during the movement and highlights the potential role for objective tools to enhance training and education of judges and riders.

When trying to establish the quality and 'correctness' of dressage movements, subjective feedback and evaluation is more often than not relied upon. This study identifies the potential role of objective analysis tools for assisting in the development and education of dressage riders, trainers and judges.

The difference between minimal and maximal riding influence on limb phasing symmetry in the sporthorse

Sonneveld, D.[1], Van Koningsveld, M.[1,2], Schreuder, M.[3], Pille, F.[4] and Back, W.[1,4], [1]Utrecht University, Department of Equine Sciences, Yalelaan 112, NL-3584 CM Utrecht, Netherlands, [2]Hogeschool Van Hall Larenstein, Droevendaalsesteeg 2, NL-6708 PB Wageningen, Netherlands, [3]NHB Deurne, Bruggenseweg 11A, NL-5752 SC Deurne, Netherlands, [4]Ghent University, Department of Surgery and Anaesthesiology of Domestic Animals, Salisburylaan 133, B-9820 Merelbeke, Belgium; d.c.sonneveld@students.uu.nl

One of the key elements in horse riding has been generally accepted to be a symmetrical movement pattern. Moreover, a horse that is asymmetrical in its locomotion may be more susceptible to overload injuries of structures in the neck, back and limbs. Recently, dressage judges, however, have been shown to be too subjective when scoring gait symmetry and thus need objective supportive information. The aim of the current study was to investigate how a rider will affect the symmetry in the movement pattern of the horse compared to lunging, using a new, turn-key and mobile gait analysis system. Twelve Dutch sporthorses (mean ± SD 10.3±4.3 years) were used to perform in each of three exercise protocols. During the lunging control protocol (L), horses were kept unrestrained and the handler used primarily voice commands with some additional support of the lunging whip. The minimal influence riding (minR) protocol was performed mounted, with the rider giving only minimal rein-, leg- and seat aids. Transitions were made using voice-aids. During the maximal influence riding (maxR) protocol the rider was asked to straighten and collect the horse as much as possible. A combined set of 3D inertial sensors (Pegasus Stride System®) were inserted in brushing boots attached to each cannon bone and thus was used to objectively determine the limb phasing of the group of horses (n=12) during L, minR, maxR at walk and trot on the left and right rein. A one-way repeated measures ANOVA was used to compare the data from L, minR and maxR with a post-hoc Bonferroni correction ($P<0.05$). It appeared that there was a significant increase in symmetry of the limb phasing between L and minR ($P<0.05$). However, there was no significant difference between L and maxR and between minR and maxR. The findings suggest that riding with minimal influence maximally improves the horses' limb phasing. However, riding with maximal influence, and thus exerting pressure on the horse to collect and straighten the horse, shows a similar symmetry in limb phasing as unrestrained lunging in its natural gait.

The use of maximal aids in the training of sporthorses appears to reduce symmetry in limb phasing and thus might increase the risk on asymmetry-related injuries.

Modern analysis of carpal joint movement at different walking gaits using a new inertial sensor modality

Van Praag, V.M.[1], Otten, E.[1], Hodgins, D.[2] and Back, W.[3], [1]University of Groningen, Human Movement Sciences, A. Deusinglaan 1, Groningen, Netherlands, [2]European Technology for Business (ETB), St. Albans Road, Codicote, United Kingdom, [3]Utrecht University, Department of Equine Sciences, Faculty of Veterinary Medicine, Yalelaan 112-114, Utrecht, Netherlands; v.v.praag@gmail.com

A database of joint angle data during movement could support early recognition of musculoskeletal diseases of the front limbs in the field for its function in dressage or in the clinic at a veterinary clinical examination. The purpose of this study was to evaluate how stride duration and carpal joint angle interact at different types of walk. Forelimb movement of four sound adult Dutch Warmblood dressage horses competing at different levels of competition were measured using the Pegasus Stride System®, containing triaxial accelerometers and gyroscopes. Two sensors were mounted on the left and right metacarpus and two on the radius of each forelimb. External influences were limited and the different types of walk were performed in a random sequence. The stride duration and the ROM of the carpal joint were measured during the natural, collected, and extended walk. For statistical analysis a One-way variance analysis (ANOVA) was used ($P<0.05$). It appeared that the mean stride duration (±SD) was significantly different between the three walking types (natural: 1.18±0.03s, collected: 1.21±0.05s, and extended: 1.14±0.03s; $P<0.05$). There was no significant difference in carpal ROM (degrees) between the three different types of walk or between the left and right limb. In conclusion, using this new inertial sensor modality, stride duration could be accurately measured, while showing a decrease going from a collected to a natural, and finally to an extended walk, suggesting a concomitant increase in stride frequency when at the same speed. The joint angles of the carpus, however, did not change, indicating that this ROM is not relevant for the limb timing difference between the three walking types. These data could be used for modelling forelimb locomotion to early detect locomotor disturbances. Furthermore, calculating the relative leg length could give different results with respect to storage of elastic energy or absorption of the impact of the collision during stance at different types of walk.

Based on these prelimary data, stride duration decreases going from a collected to a natural, and finally to an extended walk, while the joint angles of the carpus, however, does not change, indicating that this ROM is not relevant for the limb timing difference between the three walking types.

Effects of warm up on stride characteristics in the horse; a preliminary study

Northrop, A.J.[1], Blundell, E.L.[2], Martin, J.H.[3] and Hobbs, S.J.[4], [1]Anglia Ruskin University, Department of Life Sciences, East Road, Cambridge, CB1 1PT, United Kingdom, [2]Myerscough College, Department of Equine and Animal Research, Preston, PR3 0RY, United Kingdom, [3]Myerscough College, Department of Agriculture and Countryside, Preston, PR3 0RY, United Kingdom, [4]University of Central Lancashire, Department of Sport, Tourism and the Outdoors, Preston, PR1 2HE, United Kingdom; alison.northrop@anglia.ac.uk

Exercise prior to competition or a workout is a well-accepted procedure however there is limited evidence to quantify its effects in the horse. An appropriate warm-up will optimise performance through priming the neuromuscular and cardiorespiratory systems, increasing joint range of motion and protecting muscle fibres by allowing greater stretch and force without causing injury. The aim of this study was to carry out a preliminary investigation of the changes that take place during a warm-up in horses by assessing joint kinematics. Six horses of similar physical fitness that were ridden by the same rider on the same day were exercised using a standardised active warm-up procedure. The warm up followed a specific protocol and was carried out using a consistent light-rein contact in a 60x20 m indoor arena. The first phase (0-10 minutes) involved work using the whole arena (with no circles). The second phase (11-20 minutes) involved use of 20 m and 15 m circles in addition to whole arena exercise, both phases of the warm-up used walk, trot and canter. Sagittal plane kinematics of the fore and hind limb in ridden trot were captured at 300 Hz using an 8 camera Qualisys Oqus system. Kinematic assessment was measured at 0, 10 and 20 minute intervals. Heart rate (HR) was monitored throughout the trial. Repeated measures ANOVA were used to investigate joint kinematics of the fore and hind limbs and General Linear Model was used to assess horse heart rate in each gait. A significant ($P<0.01$) increase in range of motion (ROM) in the stifle joint was found after 10 minutes of warm-up. Mean ROM ± SE in the stifle joint was 42.82 ± 0.74^0 at 0 minutes, 44.89 ± 0.69^0 at 10 minutes and 46.15 ± 0.54^0 at 20 minutes. There were no significant differences of ROM in other fore and hind limb joints. There were no significant differences in heart rate between horses, indicating that all horses were working at a similar intensity.

An effective warm-up would be expected to increase muscle extensibility, force of muscle contraction and joint ROM. The findings suggest that 10 minutes exercise prior to a workout result in some improvement in stride characteristics. Additional information about muscle activity in combination with joint ROM would, however provide greater understanding.

Assessment of sensitivity to pressure in the girth area before and during a foundation training in ten horses

Van Iwaarden, A.[1], Heleski, C.R.[2] and Clayton, H.M.[3], [1]University of Edinburgh, Royal (Dick) School of Veterinary Studies, Easter Bush, Roslin, Midlothian EH25 9RG, United Kingdom, [2]Michigan State University, Department of Animal Science, 1290 Anthony Hall, East Lansing, MI 48824, USA, [3]Michigan State University, College of Veterinary Medicine, D202 Veterinary Medical Center, East Lansing, MI 48824, USA; svaniwaarden@hotmail.com

Girthing is for the horse possibly the most challenging habituation event, but some remain very sensitive and potentially experience a noxious sensation in response to pressure in the girth region, which may result in dangerous and stressful situations. The aim of this study was to investigate girth sensitivity from a behavioral perspective. Ten naïve, two-year-old Arabian horses were tested ten times throughout a 3-month foundation training to assess their reactivity to manual pressure in the girth region before the introduction of a surcingle and during training with a surcingle and a saddle. At the time of testing the examiner graded the reactivity responses into 4 categories; 0 nonresponsive, 1 mild, 2 moderate, 3 severe, and also scored the average response on a 15 cm visual analogue scale. Tests were recorded on videotape and the 100 video clips were scored retrospectively with the same categorical grading system by 3 examiners, who were blinded to the stage of training of the horses. Subsequently the 3 observers identified and counted all conflict/stress/ frustration behaviors during the tests.On manual pressure none of the horses scored 0, 6/10 always showed mild responses, 1 horse always showed mild to moderate responses and 3/10 horses usually showed moderate to severe reactivity. The visual analogue scores showed that the 2 most highly reactive horses showed an increase in reactivity over time, where the other horses showed a decrease. A strong correlation was found between the categorical scores and visual analogue scale (R^2=0.91) for the examiner who used both grading systems. The trainer reported that by the end of the foundation training none of the horses showed a problem with tightening the girth. For the video analysis the 3 observers agreed 50.5% overall and the highest overall agreement between two observers was 76.5%. The most frequently observed behaviors were: ears back, tail swishing, and bite threats. Sensitivity to manual pressure in the girth area does not appear to predict problems with girthing. Instead the tests seem to indicate the sensitivity, reactivity and temperament of the individual horse.

A study of sensitivity to pressure in the girth area showed consistent responses over time within each horse before and during foundation training. Responses did not predict problems with girthing as all horses adapted well to the tack. Instead the tests seem to indicate the sensitivity, reactivity and temperament of the individual horse.

Influences on the pressure exerted on the back of the driving horse

Randle, H., Willetts, L. and Counsell, A., Duchy College, Equitation Science, Duchy College, Stoke Climsland, Callington, Cornwall, PL17 8PB, United Kingdom; hayley.randle@duchy.ac.uk

Equipment placed on the equine back in ridden equestrian activities has been found to impact negatively on spinal pathology, soundness, performance and consequently welfare. The centre of pressure, distribution of forces, velocity and forward acceleration are influenced by poorly fitting tack. A correctly fitted carriage should be equally balanced on both sides of the vehicle regardless of the weight of the driver and groom(s) and result in an even distribution of pressure under the saddle pad. Objective data on the distribution of pressure under the saddle pad are currently not available. The effect of horse/pony, carriage type (two- or four-wheeled) and the presence of a passenger on the distribution of pressure under the saddle pad was investigated. Six horses and 6 ponies of various breeds, heights, ages and sexes were examined whilst engaging in their usual warm-up regime prior to a British Driving Society class in the Wales and West region, UK, 3 of each pulling 2 wheeled vehicles and 3 of each pulling 4 wheeled vehicles. All subjects wore their usual competition equipment and were driven by their usual driver. Port Lewis Impression Pads™ (PLIP) were rolled to a uniform depth and positioned securely under the saddle pad. Subjects were driven for 20 min then halted and the PLIP removed and placed on a flat surface. The depth (mm) of the indentations at 8 pre-defined equi-distant points were measured immediately using a digital depth meter on the left and right sides. Greater pressure was observed on the pad with horses (14.05± 1.63) than with ponies (11.7±3.15; $F_{1,125}$=10.5; P<0.01). The presence of a passenger did not have an impact on the pressure on the saddle pad. Significantly greater pressure on the driving pad was evident with 4 wheeled (14.35±1.64) than 2 wheeled vehicles (11.39±2.87; $F_{1,125}$=43.4; P<0.01). The distribution of the pressure varied significantly ($F_{1,125}$=13.8; P<0.01) with greater pressure exerted near to the withers and at the bottom of the saddle pad on both sides. Using objectively measured data this study demonstrated that although no bilateral imbalances were observed, significantly greater pressure was exerted at all points on the saddle pad by 4-wheeled vehicles than 2-wheeled vehicles. The application of emerging equitation science could assist the assurance of the welfare of driven horses/ponies.

The use of simple technology such as the inexpensive Port Lewis Impression Pad™ which allows a visual examination of the fit of the saddle pad is helpful for assessing the fit of equipment worn by driving horses and ponies. The presence of pressure on the pad demonstrated that there may be difficulties with the correct fitting of tack to horses driven with 4-wheeled vehicles.

Repeatabilities and inter-observer reliabilities of scores from temperament tests integrated into riding horse performance tests

König V. Borstel, U., Pirsich, W., Bruns, E. and Gauly, M., University of Göttingen, Animal Science, Albrecht-Thaer-Weg 3, 37075 Göttingen, Germany; koenigvb@gwdg.de

Current scores for equine personality traits assessed during performance tests are characterized by high means (e.g. mean temperament scores: 8.3 out of 10 possible scores) and insufficient variation (standard deviation: 0.8), hampering genetic selection for these traits. A number of behaviour tests have been developed in order to objectify the assessment of equine personality, although rarely they have been validated for their use as a selection tool. Thus, the aim of the present study was to integrate a temperament test based on 3 novel stimuli into horse performance tests, in order to assess variability and repeatability of horses' reactions to these stimuli and the reliability of the judges' assessment. The stimuli were comprised of a novel visual (VS), a novel visual and tactile stimulus (TS), and a novel visual and auditory stimulus (AS). A total of 224 stallions and mares of various German riding horse breeds (age: 3.4±0.9 years) were subjected to the test during their participation in station performance tests, and 133 of these horses were subjected to the test a second time either 2-3 weeks or 18 weeks after the first test. Horses were ridden in the test by professional riders, and their reactions to the stimuli were evaluated each by two judges (the respective performance test judge and the experimenter) and the rider using scores on a scale from 1 (task not concluded) to 10 (completely calm but attentive horse). Scores were characterized by lower means and larger standard deviations (e.g. TS: 6.6±2.4) compared to conventional temperament scores. Inter-observer reliabilities and repeatabilities were calculated from variance components obtained from a repeated measures analysis. Inter-observer agreement between the judges ranged between 0.89 (AS), and 0.95 - 0.96 (VS and TS, respectively) and was also very high (0.93) for the combined score given by the rider compared to the judges' scores averaged across the three stimuli. Repeatabilities of horses' scores from their first and second temperament test were 0.72 (VS), 0.75 (TS), and 0.69 (AS) and difference in time between tests did not ($P>0.1$) influence scores. Thus, the temperament test yields reliable and repeatable results. However, correlations to traits from the conventional evaluation of personality were low or non-existent, supporting earlier findings that the conventional evaluation lacks universally accepted guidelines and objectivity.

Temperament tests using novel stimuli are a practical and valid tool for improving the conventional assessment of equine personality traits during performance tests.

Objectifying the assessment of equine personality traits using behavioural and physiological observations from performance test training

Pasing, S., Gauly, M. and König V. Borstel, U., University of Göttingen, Albrecht-T.W. 3, 37075 Göttingen, Germany; koenigvb@gwdg.de

Current definitions of horse personality traits are rather vague, lacking clear, universally accepted guidelines for evaluation in performance tests. Therefore, the aim of the present study was to screen behavioural and physiological measurements taken during riding for potential links with scores the same horses received in the official performance test for rideability and the personality traits. Behaviour and heart rate from thirty-six stallions participating in a performance test were live and video recorded twice for the duration of a riding session during their performance test training. Using the coefficient of determination, regression analysis revealed that about 1/3 of variation (ranging between r=0.26 (constitution) and r=0.46 (rideability during training phase) in the personality trait scores could be explained by selecting the best three behaviour patterns per trait. These behaviour patterns included frequency of stumbling (with all traits except character), head-tossing (temperament, rideability), tail-swishing (willingness to work), involuntary change in gait (character) and the rider's use of her/his hands (constitution, rideability), voice (temperament) or whip (constitution). Subsequent mixed model analysis revealed a significant (P<0.05) influence of several of the above behaviour patterns, but not heart rate or heart rate variability, on the personality traits. In addition, rideability scores from the final test were influenced by the training rider (n=9), ranging between average rideability scores of 6.8±0.4 for one rider and 8.36±0.3 scores for another rider. Also, horses ridden with their nose-line predominantly behind the vertical received higher (P<0.05) scores for rideability (8.3±0.3) than horses ridden with their nose-line at the vertical (7.7±0.2). Possibly, judges perceive horses to have a better rideability when they readily offer a more extreme poll flexion. Alternatively, riders make use of horses' better rideability by imposing a more extreme poll flexion. Some of these links, but also the non-existing links (e.g. no association between shying or heart rate and temperament scores) are rather surprising, warranting further investigation regarding the underlying causes of these relationships.

Several behaviour patterns observed during riding are linked to official personality scores and may be considered when redesigning the current evaluation guidelines. However, ethical implications of defining aversive behaviour such as head-tossing as an indicator of e.g. poor temperament, when in fact it may also be an indication of pain or poor training techniques, should not be neglected.

Suitability of thermal imaging for evaluation of saddle fit

Göing, J., Gauly, M. and König V. Borstel, U., University of Göttingen, Albrecht-Thaer-Weg 3, 37075 Göttingen, Germany; koenigvb@gwdg.de

Poor saddle fit is a common cause for back pain and subsequent behaviour problems in horses during riding. However, objective assessment of saddle fit by visual inspection is difficult as the saddle has to be evaluated both during standing and while the horse is moving. Pressure mats yield objective data, but they are very expensive and thus not widely available. Therefore, the objective of the present study was to assess the repeatability of data from thermal images taken from saddles, and subsequently to compare results from thermography with an assessment of saddle fit by a certified saddler. Saddles were divided into 6 sections (cranial, median and caudal part of each side), and mean temperature was calculated for each section from thermal images of the saddle's underside after the following standardized use: the saddle was placed without saddle pad on the horse and the horse was lunged with equally long side reins on each hand for 2 minutes at a working trot. During saddling and lunging the saddler evaluated the distribution of pressure for each field using a scale from +3 (very high pressure) to -3 (minimal pressure) with 0 reflecting an even distribution of the saddle's weight. Temperatures from the thermal images were converted into the same scale. Repeatabilities for temperature calculated from six combinations of horses and saddles (3 horses and 6 saddles) pictured three times were very high (0.96), demonstrating that repeated measurements on the same saddle are in good agreement with each other. Subsequently, 60 horse-saddle combinations (23 horses and 37 saddles) were used to compare the assessment by thermography with the evaluation by the saddler. Correlations between scores from the saddler and from thermal imaging were high (0.88); However, Bland-Altman analysis revealed a slight bias and limited agreement between the two assessment methods: the 95% confidence interval of differences between any two measurement-pairs compared to their average ranged from score 1.7 to -2.0 with an average of -0.17.

Thermal imaging yields highly repeatable results; However the method's agreement with an assessment of saddle fit by a trained saddler is suboptimal. Since neither method can be considered as the gold standard, additional comparisons with results from pressure sensors are required before deciding whether or not thermal imaging may be a useful tool for an objective assessment of saddle fit.

Factors influencing longevity of New Zealand Dressage horses

Friedrich, C.[1], König, S.[1,2], Rogers, C.[3] and König V. Borstel, U.[1], [1]University of Göttingen, Albrecht-Thaer W. 3, 37075 Göttingen, Germany, [2]University of Kassel, Nordbahnhofstr 1a, 37213 Witzenhausen, Germany, [3]Massey University, Private Bag 11, 222 Palmerston North, New Zealand; koenigvb@gwdg.de

In the present study, the influence of different variables on the number of years in competition ('longevity') of New Zealand dressage horses was examined using survival analysis. Competition records of all 2066 horses (74% male, 26% female) starting in New Zealand dressage classes in the season of 1994/1995 were followed until 2009. Median competitive life of these horses was 3 years. However, there were considerable (P<0.005) differences between breeds (e.g. Thoroughbreds: 3 years; Hanoverians: 6 years) and gender: Male horses outlived female horses (3 and 2 years, respectively). Showing horses additionally in competitions of other disciplines (eventing, show-jumping or both) did not affect horses' median longevity in dressage competitions although the pattern of survival differed slightly (P<0.005): when registered for 4 to 7 years in the sport, dressage-only horses were withdrawn at a lower rate compared to horses competing additionally in show-jumping and/or eventing, while there were no considerable difference in survival during the other times. Rider status (amateur/professional) had no influence on horses' longevity. Horses competing at higher levels (e.g. Advanced: 6 years; Open Medium: 7 years) were registered for a longer time period than horses competing at basic levels (e.g. Pre-Novice: 2 years; Novice: 3 years). Also, the younger a horse was when achieving his first placing at a competition, the longer its median career. Potentially, the early use of horses has positive effects on their health, but it also likely that the horses shown for the first time at later ages are those horses that have suboptimal performance e.g. due to health problems or lack of inherent ability to begin with. A regular acquisition of longevity data including information on culling-reasons would make a contribution to advancing horse sport and -breeding: in the long-term it might be possible to develop a system of data collection and subsequent estimation of breeding values for longevity in sport horses.

New Zealand dressage horses are used on average for a period of only 3 years in competitions, which is comparable to, though at the lower limit of results from other countries. There were considerable differences between breeds, and the younger horses were at their first start in a competition, the more years they were shown in dressage classes, although cause and effect are not know.

Cortisol response to road transport stress in calm and nervous stallions

Fazio, E., Cravana, C., Medica, P. and Ferlazzo, A., Unit Veterinary Physiology, Morphology, Biochemistry, Physiology and Animal Production, Polo Universitario Annunziata, 98168 Messina, Italy; kricra@libero.it

Cortisol may be useful as marker in predicting how an animal will respond to stressful stimuli, thus providing information on animal's temperament. To quantify the level of transport stress and the effect of temperament on the adrenocortical response, the changes of circulating cortisol levels were evaluated in eighty-four healthy experienced Thoroughbred and Crossbred stallions, 4-20 years old, after road transport in a commercial trailer (6 horses per load, stocking density: 2 m^2/horse) on a distance of 200 km for about 2.30 hours. Several experienced caretakers were asked to also answer a questionnaire, that used a 5-point scale and a 3-point scale to assess impression on each horse's temperament, on the basis of the norm and tendencies in ordinary care and daily management. Each response was given based on a scale of 1-5. They were also asked about ordinary behavioral responses. The scores were defined as follows: a score of 1 indicated that the horse had never or rarely troubled the caretaker during management, 2 occasionally, and 3 usually. On this basis the subjects were distinguished between calm (No. 64) and nervous (No. 20) stallions. Blood samples were taken at 08.00, in single box, immediately before loading, then after transport and unloading. Serum cortisol concentrations were analysed in duplicate by immunoenzymatic assay. Compared to basal, cortisol increases were observed both in calm ($P<0.001$) and in nervous ($P<0.05$) stallions after transport. RM-ANOVA showed significant effects of transport on cortisol changes ($P<0.001$). Nervous subjects showed lower ($P<0.01$) cortisol levels than calm subjects after transport; basal cortisol levels did not differ between calm and nervous subjects. No significant differences ($P>0.05$) between different age, breed and orientation were detected. The results showed that temperament could influence the adrenocortical responses of stallions after short-term transportation. The presence of the same staff for handling, loading, confinement and unloading, the same vet taking all blood samples, and the presence of co-specifics did not reduce the response to short transport stress both in calm and nervous stallions already accustomed to transport. Moreover, signs of transport stress were less pronounced in nervous stallions.

Increases of cortisol levels after road journey of 200 km confirm that cortisol is a marker of stress in horses and show that horse's temperament seems to greatly modify the susceptibility to stress, although age, breed, previous experience did not appear to have an influence.

Daily variations of plasma serotonin levels in 2-year-old horses

Bruschetta, G., Di Pietro, P., Miano, M., Zanghì, G. and Ferlazzo, A.M., University of Messina, Morphology, Biochemistry, Physiology and Animal Production (MO.BI.FI.P.A.), Polo Universitario Annunziata, 98168 MESSINA, Italy; gbruschetta@unime.it

Platelets are a good simple peripheral model, although imperfect, to study serotonin (5-HT) transporter mechanism and central serotonergic function. Horses showed higher 5-HT plasma levels than human, with an increase after trekking and a decrease in stereotypies. Moreover, the polymorphism of equine 5-HT transporter gene is considered as a candidate genetic element influencing equine anxiety, fatigue and aggressive traits. 5-HT synthesis and release are subjected to daily fluctuations but there are no data on 2-year-old horse plasma. Early handling or training may have lasting or transient positive behavioural effects in horses. The aim of this study was to investigate daily variations of platelet poor plasma (PPP) 5-HT of 2-year-old. Research was carried out on 6 healthy crossbred 2-year-old (6 females, mean age 22±5 months, mean b.w. 240±40 kg) fed with fresh forage and water, housed in individual paddocks. Blood samples were collected in October, during a 24-hr period, every 4 hr (from 5 p.m. to 5 p.m.). The experimental design included a consistent time slot for each animal sampling, in accordance with 2010/63/EU Directive. Blood cell count and haematochemical assays were within normal range reported. 5-HT plasma levels were measured by HPLC with electrochemical detector. Statistical analyses used the Student's paired t-test by the PRISM software. Results showed increasing amounts of PPP 5-HT at 5 p.m. with maximum levels at 9 p.m. ($P<0.001$ vs 5 a.m., 9 a.m., 1 p.m.) and decreasing values overnight with minimum levels at 5 a.m. ($P<0.001$ vs 5 p.m., 9 p.m., 1 a.m.). The high 5-HT levels at 5 p.m. and 9 p.m. could be related to an enhanced 5-HT output and release, probably associated with activity pulses, followed by a decrease late at night owing to its conversion into melatonin. These data may be applied in equine management in order to early monitor horse aptitude to face future training stress in sporting activities. Finally, this is a preliminary study on 5-HT daily variations of horses and no definitive conclusions can be drawn, leading to the question of physiological relevance concerning the daily variations of PPP 5-HT in 2-year-old horses. Nevertheless, these data suggest the possibility to carry out further investigations, supported by a more experimental number design, to better understand the role of 5-HT response on 2-year-old horses.

Data obtained suggest that 5-HT daily variations could be considered as an additional variable to assess the natural suitability of horses for being trained, even if the value of 5-HT levels is not utilizable as absolute value, but it is only useful in its diurnal variations when relative basal values are known.

Variation in body condition in small groups of horses

Giles, S.[1], Harris, P.A.[2], Nicol, C.J.[1] and Rands, S.A.[1], [1]University of Bristol, School of Clinical Veterinary Science, Langford House, Langford. Bristol., BS40 5DU, United Kingdom, [2]WALTHAM Centre for Pet Nutrition, Equine Studies Group, Freeby Lane, Waltham-on-the-Wolds, Melton Mowbray, Leicestershire, LE14 4RT, United Kingdom; sarah.giles@bristol.ac.uk

Despite growing concern about levels of obesity in domestic horses worldwide, variation in body condition (BC) within groups of horses has not previously been measured. Our aim was to investigate the contribution of different factors to observed variation in BC. We propose new hypotheses to account for some of the unexplained variation. A cross sectional study of 127 horses and ponies was conducted in Somerset during February 2011. At recruitment, horses lived at pasture for ≥6 h a day with at least 3 individuals per herd. BC was assessed using the 9 point Body Condition Score (BCS) and the 5 point Cresty Neck Score (CNS). The prevalence of obesity was 27.56% (BCS 7-9, 95% CI 19.79% – 35.32%). The prevalence of cresty neck was higher, 48.82% (CNS 3-5, 95% CI 40.12% -57.52%). Obesity was slightly higher in horses (29.63%) than ponies (26.39%). Cresty neck was more common in ponies (58.33%) than horses (37.04%) (P=0.01). There was a linear association between number of months in the grazing herd and odds of obesity (P=0.01). There was 2.84 times as much variation in BCS between, as opposed to within, groups but horses within herds still varied by 1.79 BCS. Final logistic regression models for both CNS and BCS contained breed and age. The model for BCS also contained worming frequency and minutes in trot per hour of ridden exercise and explained 33% of variation in BCS (R^2= 0.33) The model for CNS also contained height, plus method of feed distribution, and explained 38% of variation (R^2=0.38). The obesity prevalence measure of 27.56% at the end of the winter months is a welfare concern. Well-meaning winter management strategies may be masking natural seasonal trends in BC. The amount of variation in individual BC explained by final regression models was small and suggests other factors may be acting. Traditional factors plausibly affecting BC were measured and only partially explained variation in individual BC. Some unexplained variation could be due to factors such as differences in digestibility or spontaneous activity. However, behavioural interactions, socially mediated interference and social position may play a role. All of these will be investigated in future studies.

Factors affecting body condition (BC) and obesity were examined in herd-living horses and ponies and obesity levels of 27.56% detected. Much of the observed variation in BC could not be explained by classic management factors (e.g. food and structured exercise). It is hypothesised that within-herd factors such as social behaviour may play a role.

Appendices

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Glossary

Catenary: The slight loop in a perfectly flexible and inextensible rope or chain of uniform cross-section and density as it hangs freely from two fixed points that are not in the same vertical line. The term is used in discussions of rein tension.

Classical conditioning: The process whereby the unconditioned or conditioned response becomes elicited from a conditioned stimulus. In equitation it is the process where learned responses are elicited from more subtle versions of the same signal or to entirely new signals.

Conflict behaviour: A set of responses of varying duration that are usually characterised by hyper reactivity and arise largely through confusion. In equitation, confusions that result in conflict behaviours may be caused by application of simultaneous opposing signals (such as go and stop/slow/step-back) such that the horse is unable to offer any learned responses sufficiently and is forced to endure discomfort from relentless rein and leg pressures. Attempts to flee the aversive situation result in hyper-reactivity. In addition, the desired response to one or both cues diminishes. Conflict behaviours may also result from one signal eliciting two or more responses independently, such as using the reins to achieve vertical flexion independently of the stop/slow/step-back response, or using a single rein to bend the neck of the horse independently of its previously conditioned turn response. Similarly, conflict behaviour may result from incorrect negative reinforcement, such as the reinforcement of inconsistent responses, incorrect responses, no removal of pressure, or no shaping of responses. Often referred to as evasions and resistances.

Conflict theory: Conflict theory proposes that most unwelcome responses in animals trained with aversive stimuli are more appropriately recognised as active coping behaviours, arising from dysfunctions in negative reinforcement.

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 confusion related to the pressure that the horse should endure if the contact is deemed to be correct. In classical equitation, contact to the rein and rider's leg involves a light pressure (approximately 200g) to the horse's lips/tongue and body, respectively. Although a light contact is the aim, there are brief moments (seconds or parts of a second) when contact may need to be stronger, particularly at the start of training, or in re-training, to overcome resistances from the horse. Many contemporary horse trainers insist that the contact should be much heavier than a light connection. This view may cause progressive habituation leading to learned helplessness to the rein and leg signals as a result of incorrect negative reinforcement and/or simultaneous application of the cues. Contact may therefore need to be the focus of discussion and debate.

Cue: An event that elicits a learned response. In equitation, cues are sometimes termed aids or signals. Rein, leg, whip and spur cues are initially learned through negative reinforcement and then transformed to light cues (light rein, light leg, voice, seat) via classical conditioning because of the temporal relation between the two. In traditional horsemanship, the cues are divided into two groups: the natural cues and the artificial cues. This distinction is misleading as it neither identifies nor correlates with the two different learning modalities through which the horse acquires its responses to the cues.

These are learned through classical conditioning when a response comes increasingly under stimulus control.

Ethical equitation: Ethical equitation aims to minimize deleterious effects at the human-horse interface. It demands, in particular, that trainers and riders use minimal pressure in both contact (if relevant to the sport) and signalling and that pressure is released immediately. Furthermore, it requires trainers and riders to understand the impacts of their actions and be prepared to justify them.

Ethology: Ethology is primarily the scientific study of innate adaptive behaviour in animals, as it occurs in a natural environment; applied ethology being is the study of animal behaviour in the human domain.

Habituation: The waning of a response to a repeated stimulus as a result of frequent exposure (not fatigue).

Learned helplessness: A state in which an animal has learned not to respond to pressure or pain. This arises from inappropriate application of negative reinforcement, which results in the horse not being able to obtain release from aversive stimuli. If this continues over a period of time, the horse will no longer make responses that were once appropriate. Learned helplessness has the following characteristics: a disinclination to trial behavioural responses to pressure; lowered levels of aggression; dullness; loss of appetite; physiological and immunological changes.

Negative punishment: The *removal* of a reinforcing stimulus which makes a particular response less likely in the future.

Negative reinforcement: The *subtraction* of something aversive (such as pressure) to reward the desired response and thus lower the motivational drive.

Operant conditioning: Training the horse to respond consistently to signals through positive reinforcement and negative reinforcement.

Positive punishment: The *addition* of an aversive stimulus which makes a particular response less likely in the future.

Positive reinforcement: The *addition* of a pleasant stimulus (a reinforcer) to reward the desired response and thus make this response more likely in the future.

Punishment: The presentation of an aversive stimulus that decreases the likelihood of a response or, in the case of negative punishment, the *removal* of a reinforcing stimulus. Punishment is often used incorrectly in horse training, i.e., when not immediately contingent with the offending response. Incorrect use of punishment can lower an animal's motivation to trial new responses, desensitise the animal to the punishing stimulus and create fearful associations.

Reinforcement: The process in which a reinforcer follows a particular behaviour so that the frequency (or probability) of that behaviour increases.

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

Response: A reaction to a stimulus.

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. In horse training, a shaping program is known as a Training Scale. Not paying due attention to shaping in horse training has been associated with conflict behaviours.

Stereotypy: A repeated, relatively invariant sequence of movements that has no function obvious to the observer. A number of stereotypic behaviours are seen in horses and are erroneously referred to as stable vices. Crib-biting is where the horse is holding onto a fixed object with the incisor teeth, arching the neck and leaning backwards, with or without engulfing air with a characteristic grunting noise; in the US it is referred to as cribbing. Wind-sucking, in Australia, describes a stereotypic gripping of a fixed object with the teeth while pulling back and engulfing air into the cranial oesophagus whereas in the UK it refers to the gulping of air into the cranial oesophagus without holding onto any fixed object.

Stimulus: Any of the cues or signals used to elicit responses in horses. Often referred to as aids.

Stress (acute and chronic): Stress, in its acute form, is a short-term dysfunction of the signal-response relationship presenting variously as raised tension levels, agonistic behaviours, redirected aggression and displacement activities. Chronic stress manifests as raised corticosteroid levels, physiological disturbances, gastric pathology, repetition and ritualisation of original conflict behaviours, redirected, ambivalent and displacement behaviours, development of stereotypies and injurious behaviours, such as self-mutilation and increased aggression.

Training scale: A progressive order of training particular qualities of responses through the process of shaping. Shaping programs merit further research.

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 International Equitation Science Symposium, Australian Equine Behaviour Centre, Melbourne, Australia, 10-43.

A quick guide to statistics for non scientists

Dr. Hayley Randle
Duchy College, Stoke Climsland, Callington, Cornwall, United Kingdom

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 needed 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).

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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?

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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: Method A and Method B.
The Dependent Variable is 'success' – which can be measured by scores achieved in competition.

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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/H_1) 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, and be judged by the same judge.

5. Data analysis

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									

Exploratory, descriptive analysis

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

Confirmatory, statistical analysis is necessary in order 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*.

For this example:
t_{56}=8.40; *P*<0.001

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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.

A simple procedure is followed to relate the *P*-value to the hypotheses in order to reach a statistically sound conclusion:

- 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.)

This guide is intended to enable non-scientists to understand the statistical references made in the abstracts and presentations during the course of the ISES international conference.

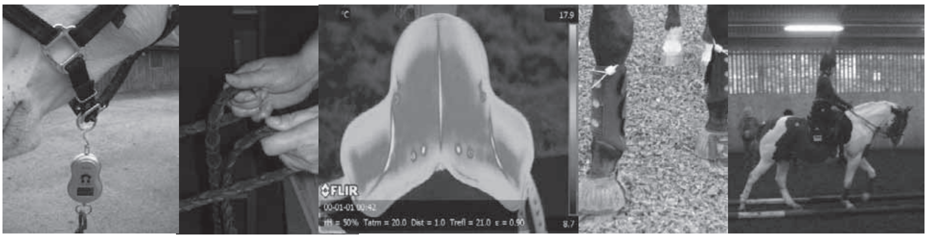
International Society for
Equitation Science

ISES UK 2012

ISES UK 2012 promises to be doubly special – firstly because the conference takes place in Olympic year in the UK– and secondly because it marks the tenth anniversary since Equitation Science was first recognised as a field of study. The three day international conference will be held from July 18th to 20th, hosted by the University of Edinburgh's, Royal (Dick) School of Veterinary Studies in bonny Scotland. The Royal (Dick) School of Veterinary Studies, established in 1823, is a world leader in veterinary education, research and practice. Integrated into the Vet school is the new International Centre for Animal Welfare which is committed to improving the quality of life for all animals through education, training and by influencing policy at the highest level.

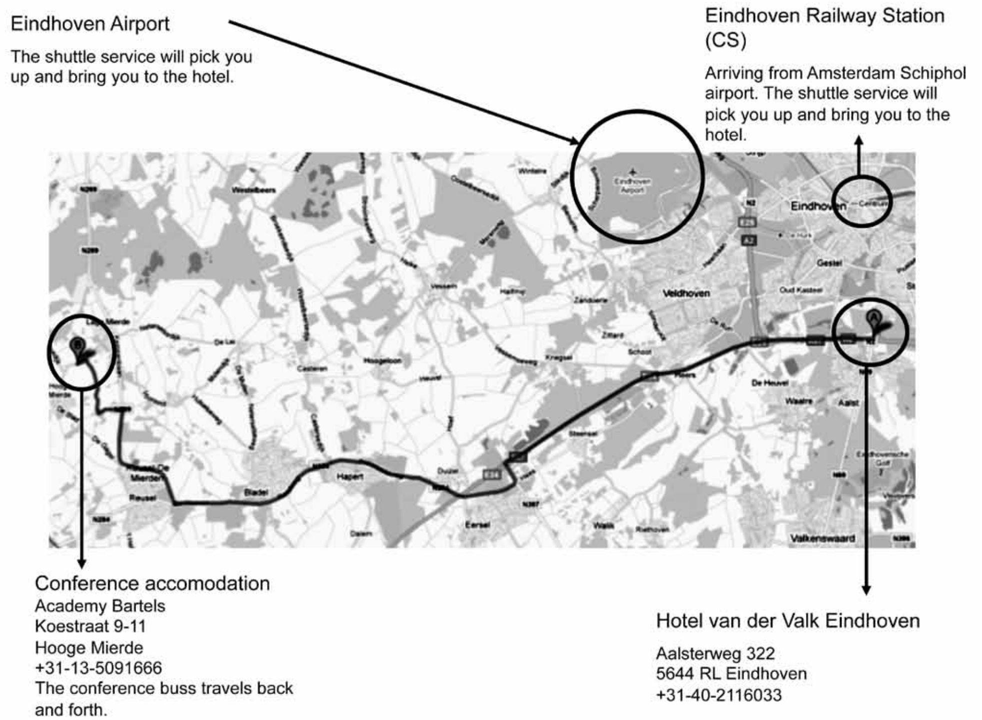
Equitation Science involves high quality translational research with the aim of improving horse welfare through the application of scientific principles addressing all areas of equitation relating to both horse and the handler/rider/driver/trainer. The conference theme: **"Equitation Science - The Road Ahead"** – will showcase how equitation science has developed as a discipline and how new innovations in technology can be used to improve practice. This conference will provide an international forum in which scientists and professional practitioners can communicate and discuss the results of research relating to training, management and the performance of the horse.

This conference will follow the usual format, with two full days of talks and discussions and a practical day. This year we have a unique slant with the inclusion of carriage driving as an equestrian discipline within the practical session.

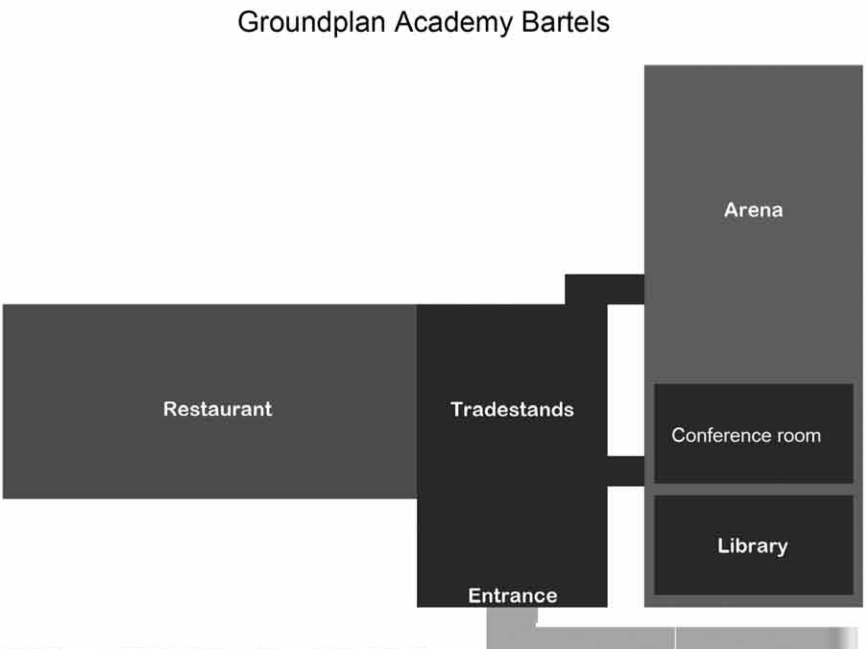


We look forward to welcoming you to Edinburgh in July 2012. Please visit the ISES website (www.equitationscience.com) to learn more about this exciting UK conference.

Map of ISES conference keypoints



Map of venue



Conference room / arena

Library

Restaurant