Part 1: Background and development of the ethogram

Why do talented horses with huge potential not live up to their promise or disappear from competition after a short career?

The horse has become an important economic commodity in its role as a sporting athlete but horses that perform less well and lose form in competition have a decreasing monetary value. Wastage is a huge problem in the equine sports industry, but the scale and cost are unknown.

Many symptoms of pain become obvious only when the horse is ridden. Many lamenesses are difficult to see or feel and may only become obvious when removed by diagnostic analgesia. Some behavioural signs can be a reflection of musculoskeletal pain, but there may be no lameness present. Sometimes, the rider can feel that the horse is not quite right, but the veterinarian is unable to identify any problems. Physiotherapists often find themselves treating the symptoms of a problem that remains unresolved. The vicious cycle can lead to diminishing performance or simply a frustrating lack of star quality, but in either case, there are welfare implications.

Horses can undoubtedly still work and compete successfully whilst experiencing some discomfort, but there is no doubt that if the primary cause was identified and managed, that they would perform better for longer. Nowadays, the margins between winning or not are tiny and we need to focus on the small gains to reap the rewards at the top level.

In her daily work as an orthopaedic specialist, Dr. Sue Dyson was aware that many owners, riders, and coaches have a poor ability to recognise signs of pain in the ridden horse. She also knew that many members of the veterinary profession have little training in pain recognition and assessment of behaviour and limited education in identification of low-grade lameness and recognition of musculoskeletal pain as a cause of poor performance.

In a study of 506 sports horses in normal work and presumed to be sound, 47% were found to be overtly lame or had other pain-related gait abnormalities (e.g., stiff, stilted canter), thus highlighting the size of the problem (Greve and Dyson, 2014). These problems are often labelled as training related, rider related, behavioural, or deemed “normal” for that horse because “that is just how the horse has always gone.”
Consequently, pain-related problems often get progressively worse, with serious welfare implications.

Sue set out to develop an effective tool for owners, riders and professional equine practitioners to facilitate the early recognition of poor performance problems in the equine athlete, promote increased welfare and ultimately, to improve career longevity. She began by studying existing literature on equine behaviour and how the use of ethograms can quantify specific behaviours. An ethogram is simply a catalogue of different kinds of behaviours observed in an animal, each with strict definitions. It became clear that a gap in current knowledge existed, because a method of assessing behaviours specifically in the ridden horse did not exist. So began a quest to find a solution to this vitally important issue that would span several years and remains ongoing work today.

**Development of the Ethogram**

A progressive series of research studies was undertaken, aiming to develop an ethogram that could be applied to the ridden horse. The series of studies was specifically designed to identify and then accurately assess behaviours in the ridden horse that could be indicators of pain and lameness.

**Study 1**

The first study to be undertaken was supported by World Horse Welfare and the Saddle Research Trust and was designed to develop an ethogram describing facial expressions in ridden horses (Mullard *et al.*, 2017). The aim of this study was firstly to develop and test an ethogram to describe facial expressions in photographs of ridden horses and then to determine whether individual people could interpret and correctly apply the ethogram, with consistency among assessors. It was anticipated that the resulting ethogram would then be applied in future studies to assess photographs and video recordings of ridden horses and to test for differences in expressions due to pain or stress.

The assessors were volunteers with a varied equestrian background, including amateur horse owners, students, coaches and veterinary professionals. After basic training, the assessors had a good agreement when scoring photographs. Examples of the features that were scored included ear position, whether the white of the eye was showing, if the mouth was open and if the horse was “above the bit” or overbent. Although there was some inconsistency in recognising more subtle features of the eyes and muzzle, it was concluded that the ethogram could be used reliably by people of different backgrounds and experience.
‘Happy’ facial expression and head posture

“Unhappy” facial expression and head posture: the ears are back, there is an intense stare, the lips are separated exposing the teeth and the front of the head is slightly behind the vertical.
The next step was to evaluate if the presence of musculoskeletal pain could be determined from the facial expressions of ridden horses (Dyson et al., 2017). Once again supported by World Horse Welfare and the Saddle Research Trust, the aim of this study was to determine if there were differences in facial expression in lame and non-lame horses when ridden, which could facilitate the identification of horses experiencing pain.

Over 500 images of lame and non-lame horses trotting and cantering were assessed. Over 50 of those images were of horses before and after diagnostic analgesia had abolished lameness. It was shown that the application of the ethogram could indeed differentiate between lame and non-lame horses and unsurprisingly, the pain scores for lame horses were higher than non-lame horses. The total pain score and head and ear position scores were reduced in horses after abolition of lameness.

The best indicators of pain were: the horse being severely above the bit, twisting the head, the bit pulled through to one side of the mouth, ear position and eye features (such as showing the white of the eye, the eye partially or completely closed, muscle tension behind the eye and an intense stare). Although greater detail can be derived from still images than from whole horse video recordings, dynamic changes in behaviour such as teeth grinding, that occur over a period of time, cannot be assessed from still images.

*Indications of pain: the ears are back, there is an intense stare with tension in the muscles above and behind the eye, the nostril is flared with angled sides, the lips are separated exposing the teeth and the front of the head is in front of the vertical.*
The study achieved its aim by demonstrating that assessment of facial expression could potentially improve recognition of pain-related gait abnormalities in ridden horses. The results clearly signposted the way towards further work and were a significant development toward the assessment of welfare in ridden horses.

**Study 3**

The previous work had highlighted the need for the development of an ethogram for a pain scoring system in ridden horses. The next study, again supported by World Horse Welfare and the Saddle Research Trust, set out to develop an ethogram for assessment of whole horse behaviour during ridden exercise based on evaluation of video footage (Dyson *et al.*, 2018a).

The ethogram was developed with 117 behavioural markers using video footage of 24 lame and 13 non-lame horses. Each horse was graded twice in random order and behavioural markers that were not consistent across both assessments were removed from the ethogram, leaving 70 markers. The modified ethogram was again applied to videos of lame and non-lame horses. Similar behaviours were amalgamated and markers that were not reliable indicators of lameness were omitted. The ethogram was finally simplified to 24 behaviours, the majority of which were at least 10 times more likely to be seen in lame versus non-lame horses. From this sample of horses, the maximum score for the lame horses was 14 out of a possible 24 compared with a maximum of 6/24 for non-lame horses.

For lame horses the following behaviours occurred significantly more: ears back for at least 5 seconds, mouth opening with separation of the teeth for at least 10 seconds, tongue out, an intense stare or glazed expression for at least 5 seconds, repeated exposure of the white of the eye, going above the bit for at least 10 seconds, repeated head tossing, repeatedly tilting the head, unwillingness to go, crookedness, hurrying, changing gait spontaneously, becoming disunited in canter or repeated incorrect strike offs into canter, resisting, and stumbling or toe dragging.
Behaviours that occur more in lame horses: ears back, intense stare, mouth open with separation of the teeth and exposing the tongue, front of head in front of vertical and tail swishing.

Although further research would still be necessary to verify this new ethogram, the results clearly indicated that recognition of these features as potential indicators of musculoskeletal pain could enable earlier recognition of lameness. All horses are capable of these identified behaviours, but a horse in pain is likely to show not only more of those behaviours but also show them for longer periods of time.

Horses that resist commands are often labelled as problem horses and may be exposed to a more intense and sometimes punitive training regimen. Application of the ridden horse pain ethogram in future could therefore help to avoid punishment-based training.

Study 4

Writing in a commentary piece (Gleerup et al., 2018), authors of previous work describing facial expressions in horses presented some concerns about the study designs of the recent studies by Dyson et al. Although in agreement that horses being ridden when in pain is a welfare concern which deserves investigation, Gleerup et al advised that the transfer of behaviour-based pain evaluation systems developed for clinical science to
ridden horses must be done with caution, since research methods specific for evaluation of pain in equitation science have not been validated.

In a robust response to Gleerup et al, Dyson and her co-authors (Dyson et al., 2018c) pointed out that the studies to date were simply stepping stones toward a gradual improvement of our understanding, knowledge and education, ultimately leading towards complete behavioural indicators in ridden horses in relation to pain. Although based on the pioneering work by Gleerup et al., the current work sought to determine if assessment of facial expression could potentially improve recognition of pain-related gait abnormalities in ridden horses.

The current studies also highlighted the process of evaluating many more facial indicators for visibility and reliability in scoring, which has not been done previously. Because there is a clear need to develop practical tools that could easily be used both by horse owners and industry professionals, it was also considered important to define the behaviours in a manner that was more user-friendly for non-scientific observers.

Defining pain behaviours in user-friendly language: this horse is showing resistance to go forward, having veered away from the track, ignoring the rider’s aids. He swished the tail repeatedly. The front of the head is in front of the vertical, the white (sclera) of the eye is seen and the mouth is open, exposing the teeth.
By comparing nonlame and lame horses, the results of the current studies enabled the addition of a more sophisticated tool to a lameness examination to improve its recognition, investigation and successful treatment. The development of the ridden horse ethogram is part of an evolution to assess pain in ridden horses because traditionally lameness examinations are performed in hand. If a ridden horse shows improvement in lameness but still shows an unwillingness to go forward freely, persistent alterations in facial expression (e.g., ears back), or other behavioural abnormalities, additional sources of pain (e.g., sacroiliac joint region pain; ill-fitting tack; rider-induced behaviour) can be investigated. By utilising these behavioural observations diagnostic skills are enhanced.

**Study 5**

Having developed, tested and combined a ridden horse ethogram with a pain score, the next step was to determine if the system could be used to differentiate lame horses before and after diagnostic analgesia had substantially improved lameness, and then to verify its use in comparison of non-lame and lame horses (Dyson et al., 2018b). This next study in the series, also generously supported by World Horse Welfare and the Saddle Research Trust, was carried out by retrospectively assessing video recordings of a sample of lame horses before and after diagnostic analgesia had resolved the baseline lameness and improved any gait abnormalities seen in canter. After abolition of lameness, the total sum of scores was significantly reduced, thus verifying that the abnormal behaviours were pain induced.

Comparing lame horses with non-lame horses, it was found that:
- A rushed gait with irregular rhythm occurred twice as frequently in lame horses
- A disunited canter or repeated lead changes occurred 7 times more often in lame horses
- Most non-lame horses scored below 5 out of a possible score of 24
- A score of 8 or more was likely to reflect lameness or other musculoskeletal pain
Before diagnostic anaesthesia: an intense stare, the front of the head is behind the vertical and the mouth is open with separation of the teeth.

After diagnostic anaesthesia: the ears are forwards and the front of the head is vertical (Note also the improvement in neck and back posture.)
As is often the way in research studies, an individual case may stand out as being of particular interest by providing deeper insight, or which may provide clear direction for future work. In this study, an upper level dressage horse was observed to work easily in working paces, but visibly struggled with collected canter, canter pirouettes and flying changes. This horse showed dramatic changes in behaviour including facial expression, which were markedly improved after analgesia. This single case study highlighted the necessity to apply the ethogram to all aspects of a horse’s work.

This study achieved its aim by successfully demonstrating that the ridden horse pain ethogram was able to differentiate between lame horses before and after diagnostic analgesia and between nonlame and lame horses.

**Study 6**

The previous study suggested that a reduction in the number of behavioural markers following abolition of pain causing lameness using diagnostic analgesia would add weight to the value of behavioural assessment in the evaluation of ridden horses. In a practical setting, the ethogram will normally be used by assessors after limited training and therefore it was considered important to assess whether it would perform as well under field conditions. It was hypothesised that there would be a significant reduction in behaviour scores after resolution of pain by diagnostic analgesia determined by both the trained and the untrained assessors. The next study therefore set out to test this hypothesis by reviewing video recordings of 21 horses ridden by professional riders before and after musculoskeletal pain had been substantially improved using diagnostic analgesia (Dyson and Van Dijk, 2020).

The video recordings showed that all the lame horses appeared most lame when ridden, with the lameness grades ranging from 1–4/8 and the most frequent grade being 2/8. After abolition of lameness all horses were graded 0/8. The number of behaviours exhibited by the lame horses prior to diagnostic analgesia ranged from 3 to 12/24. After lameness and overall performance (e.g. quality of canter or trot half pass) had been substantially improved using diagnostic analgesia, the number of behaviours observed ranged from 0 to 6/24. The reduction in behaviour scores between before and after diagnostic analgesia ranged from 2 to 12/24. The often-substantial reduction in behaviour scores after resolution of musculoskeletal pain determined by all assessors was in agreement with the hypothesis and underlined that these behavioural markers are, in combination, a likely reflection of pain. One horse did not show overt lameness but exhibited a bilateral hindlimb toe drag and had a behaviour score of 11, which reduced to 4 after diagnostic analgesia.
Before diagnostic anaesthesia: the head is tilted, there is an intense stare, the whites of the eyes are exposed and the front of the head is behind the vertical.

After diagnostic anaesthesia, the head is straight, the ears forwards and the front of the head is closer to the vertical.
Untrained assessors were in fair agreement, amongst each other and with the trained assessor, for evaluation of lame horses. Thus, for non-trained observers, the ethogram is likely to show acceptable performance in detecting musculoskeletal pain. The assessors found it easier to observe the presence of behaviour than its absence. Certain behaviours, such as ‘intense stare’, the ‘bit pulled through the mouth’, or a ‘rushed gait’, were challenging for an untrained assessor to identify. This work had therefore identified priority areas for training.

The study also assessed the accuracy of a cut off of 8/24 behaviours as an indicator of the likely presence of musculoskeletal pain, by comparing values of 7, 8 and 9. The highest combined sensitivity and specificity, indicators of accuracy, was for a score of 8 behaviours, validating previous observations.

The results were based on horses working on the flat, but it is likely that the ridden horse ethogram is transferable to other work disciplines and when jumping. The behavioural signs utilised in the ethogram may be easier for a rider or trainer or a non-specialised veterinarian to recognise than low-grade lameness and therefore facilitate the identification of an underlying pain-related problem and to monitor longitudinal progress after treatment.

**Study 7**

The objective of this prospective, observational study was firstly to compare real-time application of the ridden horse ethogram with analysis of video recordings of the horses by a trained assessor; and secondly, to determine whether veterinarians, after preliminary training, could apply the ethogram in real time in a consistent way and in agreement with an experienced assessor (Dyson et al., 2019). This study was generously funded by World Horse Welfare, who also provided the facilities.

Many members of the veterinary profession have had little training in equine pain recognition and limited education in assessing ridden horses and recognition of musculoskeletal pain as a cause of poor performance or abnormal behaviour. There was therefore a need to determine whether equine veterinary surgeons could be trained to reliably identify these behavioural signs. Ten equine vets volunteered to take part and were given initial online training and were then required to assess video recordings of 6 ridden horses. They were provided with feedback about their performances, before the study itself.

During the live testing day, all the horses were ridden by their usual riders and performed a standardised dressage style test. All the horses were in normal work and believed by their owners to be sound. The horses’ gaits were evaluated by an independent expert, who determined that 16 horses (80%) exhibited low-grade lameness, all of which were
lame on more than one limb; nine of these horses also showed gait abnormalities in canter. The most frequent lameness grade was 2/8. There were only four non-lame horses (20%). The proportion of lame horses was disturbingly high and substantially higher than previously documented from convenience samples of sports horses in regular work. Lameness was not present continuously in all lame horses and varied depending on the direction of movement and circle diameter.

Overall there was a good correlation between the experienced assessor’s Ridden Horse Pain Ethogram scores and the mean scores for the test observers. There was a highly significant difference between ethogram scores for non-lame and lame horses. The majority of lame horses had a score of 8 or more, concurring with previous observations. There was good agreement between the expert’s retrospective assessment of the video recordings and the live scoring.

This study verified that the presence of 8 or more behavioural markers is likely to indicate the presence of musculoskeletal pain, but some lame horses score less than 8. Most importantly, the study also demonstrated that the ethogram could be applied consistently by an experienced assessor using either video recordings or live horse evaluation, and also by equine veterinarians who had received preliminary training. It demonstrated to the participating veterinarians that the ethogram was a powerful tool to help them identify if a horse had an underlying pain-related problem even if they struggled to recognise lameness.

Ten equine vets volunteered to take part in the study to assess their abilities to apply the ethogram
Conclusion

This series of 7 peer-reviewed developmental studies gives credibility to the evaluation of ridden horse behaviour as a means of identifying the presence of an underlying pain-related problem. Horses are trying to communicate with us. We need to learn to listen to them and understand. Early recognition of problems and appropriate investigation and management are the keys to happy athletes and longevity of performance.

The next step was to determine if the ethogram could enhance diagnostic skills by actually using it in the field. In part 2, we will document how the ethogram has been successfully applied to clinical work.

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References


