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Rider impacts on equitation

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ABSTRACT

Equestrianism is popular worldwide, with millions of horses and riders participating in competitive horse sports and non-competitive leisure riding. Riders have a duty of care or responsibility for their horses and should aim to optimise their health and welfare. Despite this, limited research has explored the effectiveness and impact of equitation practice, equine management and training techniques on equine performance and welfare. The International Society for Equitation Science promotes enhanced equine welfare through an objective and evidence based approach to equine management and training, via education and research. This review explores the impact of the rider on equitation practice and how rider education could inform equine management and training regimens to promote health, welfare and performance. The experience of the rider will influence their riding capabilities, decision-making and their horse's ridden performance. Matching the personality and experience of horses and riders can create a positive partnership. Riding is a physical activity; therefore rider fitness can also influence the horse's performance and physical capacity. An unbalanced rider will not be able to give clear and consistent aids to the horse therefore affecting their behaviour when ridden. The horse will have to adapt their locomotion to account for the moving weight of the unbalanced rider which increases the physiological demands of exercise. Psychological influences can also change the way a rider interacts with their horse. Therefore the informed rider will ensure they are physically and psychologically prepared to ride. Decision making is a key part of rider responsibility. Riders, owners and keepers of horses will determine training and management regimens, which should be designed to support the workload expected of the horse. Similarly, riders should be capable of identifying potential risks of injury and be able to recognise pain and the physical representation of injury in the horse. Such knowledge should then be applied to adapt management and exercise regimes accordingly. To safeguard the horse, the responsible rider needs to be educated and informed, to make them aware of the impact of decisions they make, on their equine partner. Further research within equitation science is required to build an evidence base to support the development of educated and responsible riders. The horse-rider relationship is complex. The inability of the horse to verbalise its emotions and pain places significant responsibility on the rider to ensure that the animal's health and welfare is optimised through informed management and riding. The responsible rider should exert a positive impact upon the horse and the partnership, applying scientific principles when training and managing their horse to promote health, welfare and performance to achieve a positive horse-rider relationship.

1. Introduction

Riders, owners and trainers are responsible for the horses they manage. Their duty of care encompasses general management of the horse, for example nutrition, housing, allowing. . .expression of normal behaviour and maintaining their health and welfare. Within worldwide recreational equine populations, a substantial proportion of the welfare problems reported are linked to unintentional neglect due to owner or rider ignorance (Hemsworth et al., 2015). Clear industry guidelines exist for explicit aspects of management such as feeding protocols and stable size, but are limited within equitation, where accepted training regimes are predominately based on historic and anecdotal practices rather than informed by research (Ely et al., 2010; McGreevy and McLean, 2007; McLean and McGreevy, 2010; Van Weeren and Back, 2014). Riding manuals and qualifications are often structured to deliver the mechanics of how to control the horse or how to execute set movements, with the primary aim being to develop rider skill but with relatively

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Table 1
Horse and rider impacts on the horse-rider partnership.

Horse and rider relationship			
Rider factors:			
Status	Economic	Resources	Quality
	Job		Arenas
	Qualifications		Turnout
	Professional		Equipment
	Competitive		Coach
	Amateur		Transport
	Experienced		Access
	Para-rider		Time
	Novice Leisure		
	National		
	International		
	Young rider		
Experience	Training	Psychological factors	Age
	Environment: peers		Peer pressure
	Self-belief		Past experience
	±impact of current horses		Economic pressure
	± impact of previous horses		Selection pressure
	Quality		Success pressure
	Traditional		Context: hack vs. school vs. road vs. competition
	Modern		Environment
	Qualifications		Horse
	Industry		Mood
	Riding school only		Emotion
	Validation		External influences
	K&U: riding		
	K&U: management		
Skill	Independence	Level/training	Quantity
	Empathy		Access
	Balance		Quality
	Control		Regularity
	Context: riding school vs. road vs. competition		'fit for purpose' Horse focus
	Handling		Rider focus
	Management		Partnership focus
	Ridden		1 horse
	Personal judgement		Multiple horses
	Coach		Access to schoolmaster/quality horses
	Confidence		Stage of training
	Peer influence		Training resources and environment
	Horse influence		
	Experience		
	Ability level		
	Age		
	Success record		
Injury	Age	Ambition/goals	Short term
	Existing		Long term
	Impact of injury: psychological and physical		Level
	Compensation		External pressure: family, peers, coach, owner
	Coping strategies		Clarity
	Balance		Realism
	Ridden influence		Viability
	Management influence		Economics
Equine partner	Horse/s	Support network	Coach
	Match		Family
	Prior experience		Friends
	Previous horses		Yard peers
	Focus: behaviour vs. talent		Competition peers
	Aware of strengths and weaknesses		SelectorsParaprofessionals: vet, physiotherapist, farrier
Economic status	Professional	Physicality	Age
	Leisure		Health status
	Success linked to income		Injury status
	Shortcuts to success		'fit for purpose'
	Producer		Hack vs. compete vs. level
	Goals: short vs. long term		Fitness
	Management		Security
	Veterinary support		Balance
	Access to resources and professionals		Weight
Personality	Extrovert, Introvert, Ambition, Emotional, Conscientious, Open to ideas		Worrier, Anxious, Nervous, Confidence, Strategic
Horse factors:			
Rider	Competency	Status/experience	Schoolmaster
	Experience		Novice
	Skill		Experienced
	Empathy		Inexperienced
	Style		Bombproof
	Balance		Good to. . .
	Aids		Sound

Table 1 (*Continued*)

Horse and rider relationship			
	Management		Discipline
	Riding		Competition level
			Injury status
			Rider status
			Horse: pet, companion or athlete
Breed	Temperament	Age	Management
	Suitability		Handling
	Size		Experience
	Characteristics		Backed
	Talent		Temperament
	Management		Impact of growth
			Training level
			Impact of prior training level/type
Temperament/personality	Matched to rider	Prior history	Known
	Experience		Unknown
	Prior history		Quality of handling, management, training
	Breed		Veterinary history
	Age		Ridden history
	Management		Habits
			Competition history
			Quality
			Prior rider/s
Health/injury	Conformation	Discipline	Training
	Fitness		Experience
	Health status		Competition experience
	Injury status		Success
	Prior veterinary history		Level
	Performance expectations		Rider status
	Capability		Talent
	Injury management		Conformation
	Training management		Injury/health status
	Rider knowledge		Discipline demands/fitness
	Risk factors		
Experience	Age	Owner	Owner is rider
	Level		Rider is not owner
	Training		Impact on decision making
	Road		Impact on management
	Management		Experience
	Rider level		Finances
			Leisure
			Amateur
			Professional
			Targets/goals
Stable management	Nutrition	Goals	Realistic
	Stabling		Viable
	Feeding		Appropriate
	Exercise/training regimens		Informed
	Behaviour		Supported
	Housing		Impact training and management
	Turnout		Impact on health, fitness and injury
	Equipment		Purpose
	Farriery		
	Veterinary care		
	Routine health care		
	Physiotherapist		
Value	Cost, cost to replace, Financial – to keep, vet care, feed, livery, Emotional, Business asset, Partner, Pet		

K&U: knowledge and understanding.
The horse-rider relationship is a complex phenomenon which is influenced by multiple intrinsic and extrinsic factors which are summarised in Table 1.

little emphasis on the well-being, health or welfare of the horse. Stable management texts are available for guidance but unless riders engage in a formal equestrian qualification such as British Horse Society examinations (BHS, 2016), the German Pferdewirt (GEF, 2015) or Equestrian Australian qualifications (EA, 2016) their knowledge and understanding of equine management, health and welfare may not be measured. As riders become more experienced, development becomes more tailored to specific and targeted goals, often related to the horse's function, for example an equestrian discipline, competition level or expected level of performance, and will potentially occur under the guidance of a coach or trainer. At this stage, development and training should become more reflective, with increased consideration of the impact of riding (self-reflection and coach input) on the horse's development and performance, and how the horse and rider can work together to form a successful partnership and achieve set goals. However in reality it is not just the physical impact of riding that will influence equine performance. Equine performance is a complex phenomenon and multiple intrinsic (e.g. fitness) and extrinsic factors (e.g. management) will interact to define an individual horse's performance at any given moment in time (Hughes and Bartlett, 2002; McGarry, 2009; Williams, 2013). Development and performance also need to be considered in the short and long term, for both the horse and the rider to reflect individual and combined progress, and to promote health and career longevity (Parkin and Rossdale, 2006; Williams, 2013). Therefore the modern rider needs to not only possess the skill to ride effectively but should also understand the wider impact of their actions during the management and riding of horses to fulfil their duty of care (Hemsworth et al., 2015). This review will evaluate the wider impact of the rider, their role and responsibilities to the horse and how these ultimately influence equitation and equine health, welfare and performance.

2. Defining the rider

To be able to evaluate the impact of the rider on the horse, we first need to know who the rider is. Unfortunately this is not a simple question. Riders are individuals who each possess their own characteristics, values, skills, experience and status which will influence their relationship with the horse (Wolframm et al., 2015) (Fig. 1; Table 1). Who they are and why they ride can change over the course of a lifetime, with age, their personal circumstances or depending on the context in which they are riding (Wolframm et al., 2015). For example the same person could be paid to ride a competition horse for an owner, could be a coach riding a client's horse, and may be developing their own horse or hacking out for pleasure or personal emotional release. Within research and lay literature, riders are often categorised according to their status and experience. However standardised definitions for different categories of rider are do not exist which limits comparison of group characteristics and their impact on equitation practice (Swann et al., 2015), for example the impact of novice versus experienced rider position on equine biomechanics. In the equine industry, riders can be considered 'novice' if they are inexperienced, 'experienced' when they have become practiced at their skill, 'amateur' once competing at affiliated[1] level above novice levels but do not compete as their career, 'professional' when their career is related to their competitive profile, or 'elite' once international competition participation has been achieved. However the majority of Governing bodies do not formally assess rider experience. Equally many horse owners do not engage in affiliated competition level, preferring to undertake leisure activities with their horse or competing occasionally in unaffiliated competition but this does not always mean that they are inexperienced. The attainment of expertise has been linked with experience through long term athlete development (LTAD) systems (Balyi and Hamilton, 2000) which require the completion of deliberate (correct) skill practice to attain expert status, for example the 10 year rule: 10 years of practice (Balyi and Hamilton, 2000; Gladwell, 2009) or the minimum of 3000 h of practice (Campitelli and Gobet, 2011) creating an Experienced Athlete. For the purposes of this review, and to promote consistency in future research, a taxonomy of rider categories for equestrian sport is proposed in Table 2, applying Swann et al.'s (2015) relative approach.

Practically, the use of multiple terms within equestrianism to describe the skill and level of individuals can confuse the rider who is looking to define who they are and to understand who their peers and industry expects them to be. Individual appreciation of the skill set possessed and how riders use this information to develop their riding skill/s to ensure their own safety is important. For example, consider the leisure rider who is an experienced riding school rider and has been deemed competent hacking and riding on the flat and over jumps to a novice level on riding school horses by a qualified instructor. Their riding assessment has occurred on horses selected for their suitability for purpose (riding school resident and for the individual rider), in a managed environment, with a positive support network (like minded peers and instructors) and with horses managed (feed, turnout, workload) to promote the level of performance required. However, the rider's own judgment of their ability could fail to consider this, they may perceive their competency has

[1] Affiliated: Awarding body managed competition which abides by National Governing Body and FEI rules and regulations, and requires registration of horse and rider to participate.

Table 2
Taxonomy of rider status categories for equestrian sport.

Category	Description
Leisure rider	Engage in hacking and unaffiliated equestrian activities
Novice rider	Rider is inexperienced and who has less than 3000 h riding
Experienced rider	Over 3000 h riding experience and has an independent seat and competent riding ability on the flat[a] (up to and including lateral work) and over jumps[a] ($\geq$1.00 m), with some competition experience in affiliated equestrian disciplines
Amateur rider	Experienced riders who regularly compete in affiliated equestrian activities but for whom equestrianism is not their main source of income
Professional rider	Experienced riders who work and/ride horses or coach as their main form of employment
Elite rider	Experienced riders who have competed at National and/or International level in a named equestrian discipline
Expert rider	Elite rider who has represented their country at the Olympic games in equestrian sport (or at the highest level of equestrian discipline-specific competition for non-Olympic sports)
Para-rider	Rider (can be inexperienced or experienced) who engages in para-equestrian activities as defined by the International Equestrian Federation (FEI).

There are no clear definitions of rider status within equitation research or the equestrian industry. Swann et al. (2015) propose a two system approach to define athlete status within research advocating an absolute approach for exceptional athletes whose performance has defined their expertise in their discipline. Whilst a relative approach is applied to assess expert status defined via their experience compared with non-experts in their sport. To progress forward and facilitate comparison going forwards a taxonomy of rider status categories is proposed.

[a] Riders may be experienced in a specific area e.g. on the flat or in jumping spheres in isolation, or in both flat and jump riding depending on their selected equestrian discipline for example eventing.

been validated by a respected industry professional, they are capable of riding multiple horses (as it is likely they will have done this in a riding school) and they feel ready to compete, purchase or keep their own horse.

Increased rider experience and education has been shown to reduce the risk of rider injury (Hasler et al., 2011). However equally important is the rider's ability to control their equine partner, which could influence the safety of other riders or the public as well as that of the rider (Hawson et al., 2010; Newton and Nielsen, 2005). Riders also need to develop competent ridden skills to be able to manage their horse, through appropriate and informed decision-making such as recognition of fatigue or lameness, in order to maintain the horse's health and prevent injury. The management and social environment horses are exposed to can alter their behavioural and physiological responses to stimuli when ridden or handled (Rivera et al., 2002). Limited knowledge and understanding of stable management and its impact upon horse handing and riding in the inexperienced or ill-informed rider, combined with potentially over-ambitious self-assessment of experience and skill-level, could prove both dangerous to the rider and detrimental to equine health and welfare (Hemsworth et al., 2015). Therefore the concept of rider responsibility should not be underestimated and should include judging the suitability of horse-rider partnerships and ensuring that riders are sufficiently educated to ensure their understanding of how to manage horses as well as ride them is appropriate, safe and promotes the health and welfare of humans and horses. Although individual riders must take ownership for their actions, it could also be argued that the equestrian industry has a broader responsibility to ensure riders have access to sufficient and suitable education mechanisms which will prepare them for horse ownership, riding and competition. Although competitive horse sports are often governed at International level and at national level no standardised system for rider development exists across eques-

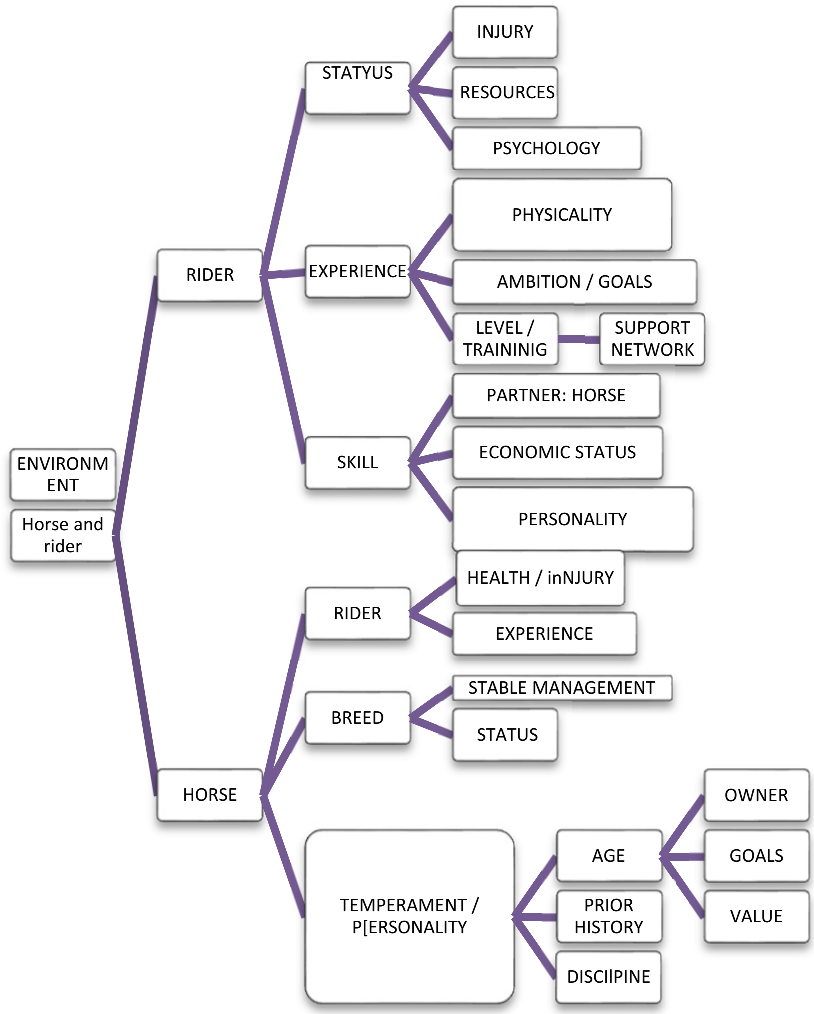

Fig. 1. The complexity of the horse-rider relationship.
The interaction of factors which influence the horse-rider relationship and the complexity of their relationships are summarised in Fig. 1.

trianism. In the UK, rider development is often nurtured through organisations like the Pony Club, Riding Clubs and the British Horse Society, competition participation, although discipline awarding bodies encourage training, it is linked to registration alone and there is no oversight or management of the leisure rider sector. In contrast, the German Equestrian Federation employs a testing system for non-leisure riders, the "German Riding Badge" or "Performance Medal" assesses theoretical knowledge and riding ability on the flat and over jumps, and must be achieved before riders are eligible to compete, whilst leisure rider competency is verified through the Leisure Rider Test (GEF, 2015). Equestrianism records high injury rates compared to other sports, for example 16–469 injuries per 100,000 people reported by Hawson et al. (2010). Detailed analysis of accident causes has shown that 'random' accidents (e.g. horse falls) account for approximately a third of incidents (33%), with a further 27% accidents associated with fear reactions of the horse (27%) perhaps due to inappropriate handling or riding (Keeling et al., 1999; Thomas et al., 2006). Therefore given the potential risk to riders and the general public from an out of control or fearful horse, systems to assess and manage rider responsibility and competency across leisure and competitive riders is worthy of future debate across the equestrian industry.

3. Psychological influences on riding

The influence of the psychological dynamics between the horse and rider team are still poorly understood despite their critical contribution to a harmonious or successful relationship with leisure and competitive riding (Von Lewinski et al., 2013). Limited research has evaluated the psychological factors that can influence the performance of the competition (Wolframm and Micklewright, 2009, 2010a, 2010b, 2011a, 2011b) and leisure rider (Wolframm et al., 2015) and how these factors subsequently impact upon the horse. Participation in competitive sports has been reported to increase cortisol production in human athletes (Crewther et al., 2011) in response to stimulation of the hypothalamic pituitary adrenocortical (HPA) axis (Cavado et al., 2006). In riding, anxiety can be categorised as a positive or negative response manifesting as pre-competition or riding nerves (negative) or anticipation (positive) depending on the psychological profile and experience level of the rider, and perhaps the horse they are riding (Williams, 2013). Raised cortisol levels have been observed in horses in response to stressors including novel stimuli (Von Borstel et al., 2010), transportation (Schmidt et al., 2010) and competition type related to horse experience level (Cavado et al., 2006) but few studies have considered the direct impact of the rider and their stress responses upon the horse. Von Lewinski et al. (2013) compared the reciprocal impact of a public performance and prior rehearsal on horse and rider anxiety using heart rate analysis analyses? Their study found that horses recorded consistently lower heart rates than their riders during both events despite elevated human heart rates during the public display. In contrast, Keeling et al. (2009) reported that equine heart rates, during leading and when ridden, mirrored those of their nervous leisure handlers/riders in anticipation of a novel object test. Interestingly equine performance anxiety has been shown to reduce with experience for horses competing in dressage and showjumping competitions (Cavado et al., 2006). These preliminary studies suggest that anxiety is reduced by experience in horses and humans, and may also be linked with development of a horse-rider partnership, therefore the novice rider may not impact as much as anecdotally considered on their equine partner supporting industry recommendations to match novice riders with experienced horses. As horse and rider partnerships often vary in the course of both parties careers, further research is required to explore this concept and examine the importance of creating and managing the impact of positive partnerships during horse and rider development and within competition.

4. Rider personality

Human dispositional tendencies have been shown to influence the individual's behaviour, and their interaction with other people, education and employment choices, family life and participation in recreational and sporting activities (Wolframm et al., 2015). Personality profiling to assess an individual's suitability for specific sports is common in human sport (Allen et al., 2014, 2013, 2012, 2011). However, profiling is a relatively new concept in equestrianism, with little consideration given to how personality traits vary between the different categories of rider and how these might influence equitation practice. Wolframm et al. (2015) applied the Five Factor Model of Personality (FFM; Goldberg, 1993) to investigate if personality differences existed for extroversion, agreeableness, conscientiousness, neuroticism and intellect between different categories of rider defined by status, experience and discipline. The results suggest the profile of a leisure rider is distinct from competitive riders of amateur and elite status. Interestingly, competitive riders exhibited significantly increased extroversion and conscientiousness scores compared to leisure riders, a profile which is consistent with results from athletes in other sports, who also record higher extrovert and conscientious scores and reduced neuroticism scores compared to normative populations (Allen et al., 2011; Woodman et al., 2010). High scores for extraversion indicates individuals who actively engage in numerous, focused interpersonal interactions whilst increased conscientiousness scores relate to more organised people who possess good time management skills and engage intensely in goal-directed behaviour (Allen et al., 2011). The competitive rider profile suggests these individuals either inherently possess or have developed the personality traits needed to succeed in sport: a deliberate and disciplined approach, effective time management, problem- solving skills, goal-setting, positive and constructive coping mechanisms for success and failure and the ability to perform under pressure (Allen et al., 2014; Hardcastle et al., 2015; Wilson and Dishman, 2015). However the leisure rider appears to possess different characteristics, being more likely to focus on negative behaviours and events, and to react more when something goes wrong when riding as they are less emotionally secure in their riding than their competitive peers (Allen et al., 2011). As personality is not a fixed concept, responses are likely to be shaped by the experience of the rider, influential environmental cues and the horses involved (Allen et al., 2011). However the differences reported by Wolframm et al. (2015) suggest that personality assessment and self-awareness could be a useful tool to predict how individuals will behave in equestrianism. Riding can be a stressful experience at all levels, but particularly for the leisure rider who is prone to experiencing more somatic anxiety (Wolframm and Micklewright, 2009) if perhaps they are not matched with the ideal horse/mount, feel they are responsible for their horse's unwanted behaviors, have fallen off recently, have low self-esteem or they feel inexperienced compared to their peers. An increased understanding of how human personality traits can influence decision making during riding (and management) could be used to help inform horse selection and be integrated into training. The utilisation of individually tailored strategies that help leisure riders to cope or plan ahead with different scenarios that can arise when riding (and managing horses) could develop confidence resulting in positive experiences for the horse and rider (Allen et al., 2014).

5. Equine personality

Equine personality is postulated to influence a horse's trainability (Visser et al., 2003) and suitability for purpose (Lloyd et al., 2008; Randle, 2015; Williams, 2013), and has been studied using traits such as excitability, anxiousness, dominance, sociability, inquisitiveness and protection (Lloyd et al., 2008). The diversity of equestrian disciplines that exist has resulted in the refinement of horse breeds in an attempt to reproduce physical and temperament characteristics which promote competitive achievement and career longevity (Stachurska et al., 2002). However, as the majority of riders and horses do not compete (BETA, 2015) the traits selected to promote success in the equine athlete are often not the same traits required by leisure riders when selecting a horse which is suitable for their needs (Randle, 2015). Breed specific traits have been suggested to exist; generally Thoroughbreds, Arabians and Welsh Ponies and Cobs are considered to exhibit an increased tendency to be excitable and anxious compared to breeds with draft origins (Hausberger et al., 2008, 2004; Hayes, 1998; Lloyd et al., 2008). Therefore horses with a high percentage of draft origin may be more suitable for the inexperienced and leisure rider. However, it is not quite this simple as many modern horses will share ancestry with multiple breeds and in breeds such as the Warmblood, Thoroughbred or Arabian bloodlines have been introduced to generate improvement within physical characteristics (McGreevy and Thomson, 2006). Personality can be considered a representation of the genetic and environmental influences upon the horse's behaviour during its development which shapes its current actions and reactions (Randle, 1998; Randle, 1995a, 1995b). Therefore whilst breed should be an important consideration when selecting an equine partner, assessment of individual horses' personality traits and behavioural responses on multiple occasions and within different environments is warranted to ensure they are suitable for their human partner (Graf et al., 2013; Wolframm, 2012).

6. Partnerships and personality matching

Horse-rider relationships will be shaped by the personality of *both* the rider and the horse, and will influence their cumulative success as a partnership (Hemsworth et al., 2015; Williams, 2013). Current research investigating horse and rider partnerships often integrates experienced riders, defined as industry capable riders, but not elite or professional riders combined with accessible equine populations housed at riding schools or universities (for example Munsters et al., 2012). Whilst this approach provides interesting data, examination of horse and rider interaction across a broader context would be worthwhile (Williams, 2013) and could be more representative of the variation which occurs across equestrianism. Evaluation of horse-rider relationships integrating riders of different status (leisure, amateur, professional) and experience (novice, intermediate, elite) across a range horse breeds and equine experience levels could facilitate an evidence base from which personality matching 'profiles' (leisure, competition) could be developed. Research suggests that inexperienced riders are less balanced than their experienced peers (Lovett et al., 2005), which would suggest selection of a horse from breeds which are considered to demonstrate increased excitable and anxious tendencies (Graf et al., 2013; Lloyd et al., 2008) may not be a suitable match. The leisure rider appears more likely to make judgements based on emotion rather than objective judgements (Allen et al., 2011; Wolframm et al., 2015). A reactive and emotional rider response to stimuli could result in the demonstration of unwanted behaviours (napping, bucking, shying) in an inexperienced horse, resulting in a negative relationship which is likely to be unsafe for both parties. Experience therefore also appears to influence the success of the horse-rider partnership. Partnering an experienced rider with inexperienced horses has been shown to support the horses' development and performance (Patterson et al., 2010; Powers and Kavanagh, 2005). An analogous relationship could exist between inexperienced riders and experienced horses, which could explain the anecdotal practice within industry of matching novice riders with older horses. More research is needed to confirm this, but it appears if one member of the horse and rider partnership is experienced the chances of the partnership being successful are increased.

7. Judging the success of the horse-rider relationship

Performance variables are often used in sport to categorise success and facilitate analysis of improvement over time for a discipline or to assess individual progression (Hughes and Bartlett, 2002; McGarry, 2009). Multiple measures of success exist in equestrianism. However, a successful horse-rider partnership may not be linked to winning or placing in an event or to the horse's future breeding potential. Achieving a clear round in showjumping, scoring above a designated percentage in dressage, completing a cross country stage at a one day event without incurring time penalties or successfully undertaking a hack which includes riding past the tree which your horse always reacts negatively to could all be individual goals which when achieved translate to success for specific horse and rider combinations. Retirement from elite sport is a relatively common occurrence within human and equine sport, with athletes pushed (e.g. injury) or pulled (e.g. spend more time with their family) (Fernandez et al., 2006). Therefore an alternative approach to define success in equestrianism could be based on how a rider manages the health, welfare and longevity of their equine partner (Parkin and Rossdale, 2006).

8. Training and management

The horse relies on its owner, rider and/or trainer to ensure it is suitably prepared and managed to be fit for the role expected of it. Regardless of the equestrian activity or discipline the horse and rider engage in, some degree of preparatory training will be needed to ensure the horse (and rider) will be able to cope with the physiological and psychological demands of exercise or competition (Ferrari et al., 2009). Training aims to develop the fitness levels and condition the horse's musculoskeletal, neural, cardiovascular and respiratory systems for the expected workload during exercise and or competition (Smith and Goodship, 2008; Williams, 2015). Ensuring the horse is sufficiently prepared for its role should reduce the incidence of injuries and concomitantly protect career longevity (Verwilghen et al., 2009). Training regimens, therefore, should not just be the preserve of the competition rider as the principles of training apply to any horse which is expected to engage in exercise. To be able to design scientifically informed training regimens, knowledge and understanding of the physiological fitness required to successfully complete the planned workload is required (Ferrari et al., 2009). Fitness analysis should be complemented by the evaluation of factors which could increase the risk of injury (Stover, 2003) for example conformation (Wallin et al., 2003), surface conditions (Murray et al., 2010; Williams et al., 2001), the horse's health status (Parkin and Rossdale, 2006), exercise demands (Singer et al., 2003; Dyson, 2002) or management of the horse (Parkin and Rossdale, 2006). Riders should also understand how to design training regimens to condition the horse to the demands of competition and develop their neural and motor skills to perform specific exercise tasks such as jumping different fence types or galloping up and down hills or performing advanced dressage movements (Dyson, 2002; Ferrari et al., 2009; Williams, 2013).

As the dominant partner in the horse-rider relationship the rider has the responsibility to make decisions which positively impact on equitation practice. Successful training regimens should include a combination of exercise types (Table 3) matched to short and long term performance goals (Leisson et al., 2008), for example being able to complete a 2 h hack three days per week or compete at a 4* event. The inexperienced or leisure rider may need support to develop their skills to be able to analyse their horse's fitness and ability to ensure they can support the exercise demands placed upon them. The ability of a horse can also influence rider safety, for example if a novice rider jumps a horse over 0.9 m fences which is capable of jumping 1.20 m easily within its capacity, there is increased potential for the horse to adapt to potential errors from the rider. However if the same rider jumps the horse at the limits of its capability, then the room for error is decreased as the horse requires the rider to enable it to perform to is capabilities for example riding a straight approach, at a suitable canter pace and judging the take off stride correctly.

Despite exercise testing, the physiological demands associated with different levels of exercise and competition demands are still not clearly defined in the horse (Ferrari et al., 2009; Munk et al., 2014). The amplitude of the response of a horse to training will vary according to the content of the specific programme implemented: exercise type, frequency, intensity, duration and volume, and the basal profile of the horse: genetic potential, conformation and prior training/fitness status and muscle fibre profile combined with its age, breed and sex (Leisson et al., 2008). The impact of the frequency, intensity, duration and volume of exercise undertaken within training relative to the horse's work: rest ratio should be assessed on a regular basis to prevent injury and overtraining (Seene et al., 2004). The rider should also consider the energy demands (Fig. 2) required to sustain the type of exercise or competition test the horse will engage in, with evaluation of the horse's current fitness level, including stamina (aerobic energy), strength (anaerobic energy) and speeds required (walk and trot, slow canter: aerobic energy; fast canter and gallop: anaerobic energy) (Marlin and Nankervis, 2002; Williams, 2015). For example, knowledge of the canter speed, distance and number of jumping efforts within a show jumping course can be used to calculate the demands of exercise (duration, intensity and volume). Combine this knowledge with an understanding that show jumping is predominately aerobic (if the horse is fit) on the flat and anaerobic over the jumps, then a rider can design and tailor a training regime to match the horse's competition needs. The rider's contribution to metabolic workload should also be considered. A fatigued or unbalanced rider will represent an increased load on the horse during ridden work which will increase the physiological demand of exercise (Douglas, 2015).

Table 3
Types of training used to prepare the horse for their workload.

Category	Description	Impact
Endurance or stamina development (EN)	• high frequency of repetition • predominately aerobic • long duration—low intensity exercises • for example, long periods of walk and trot	• improved oxidative capacity • increased capillarisation • increased mitochondria • higher ratio of aerobic muscle fibres (I and IIA)
Strength and conditioning (SC)	• discipline focused • mimics specific competition demands • aerobic and anaerobic • duration and frequency linked to skill development • for example, grid-work, jumping a course or practising collected dressage movements	• some improvement in oxidative capacity • improved motor skill acquisition • increased muscle fibre synchronicity • muscle fibre hypertrophy • enhanced neuromuscular excitability improving energy when training is linked to specific discipline demands • higher ratio of aerobic muscle fibres (IIA and IIAX)
Speed or high intensity (HI) training	• short duration-high intensity activity including anaerobic contribution • low frequency of repetition • for example, canter and gallop at 75–80% maximal exercise, canter and gallop interval training[a] or galloping on a high speed treadmill using inclines of 5–10%	• improved oxidative capacity (IIA) • muscle hypertrophy • increased capillarisation • increased mitochondria • higher ratio of anaerobic muscle fibres (IIX)

Adapted from (Eto et al., 2004; Hinchcliff et al., 2008; Leisson et al., 2008; Yamano et al., 2006).
Three main types of training condition the equine athlete for competition. Knowledge of training categories and subsequent adaptations they invoke are required to understand how training underpins performance.
[a] Interval training can be defined as repeated bouts of high intensity exercise, separated by rest periods performed on the same day.

Fig. 2. Equine muscle fibre recruitment during exercise (Williams, 2015); +++ majority recruitment; ++ medium recruitment, + minimal recruitment.
Research has demonstrated that equine muscle fibres are recruited in a consistently ranked order from I → IIA → IIAX → IIX (Rivero and Piercy, 2008). Low level exercise predominately recruits Type I fibres producing sufficient energy from aerobic fat metabolism. Medium level activity employs Type I fibres combined with Type IIA and IIAX which provide the speed of contraction required for the increased workload; energy production is still generally aerobic. In high level exercise, or prolonged submaximal exercise all fibre types are active using a combination of aerobic and anaerobic energy (Rivero, 2014) but Type IIAX and IIX fibres predominate due to their ATP generation which is required to sustain performance levels.

9. Rider fitness

The physiological ability of the rider will influence their balance and coordination and their reaction times to stimuli (within the environment and from the horse), influencing the quality of their riding. Therefore the rider is also responsible for ensuring they possess the physiological fitness and athleticism to match the demands of the equestrian activities or competition they intend to engage in (Douglas, 2015). There is a paucity of research related to human fitness within equestrianism, with a specific deficit in collection of field-based data in leisure riders and within training or competition (Douglas et al., 2012). Equestrianism has previously been compared to 'travel' sports such as motor sport and yachting (Bompa and Haff, 2009) due to the requirement for participants to have quick proprioceptive processing and complex motor skills (strength, balance, quick reaction times and endurance); all of which will require training to attain expertise. Quantifying the metabolic demands of equestrianism is problematic given the inherent variability in physiologic responses dependent on the discipline being investigated (Douglas, 2015). The limited research which has investigated the physiological demands of riding has focused to date on simulation rather than live competitive situations (Douglas et al., 2012). The results show that as the horse and rider progress through the equine gaits, heart rate and oxygen consumption increase, suggesting riding is a predominately aerobic activity supporting increased isometric muscular contraction particularly of the abdominal and back muscles associated with balancing, which in elite athletes is demonstrated by a more controlled upright trunk position (Douglas et al., 2012; Lovett et al., 2005; Terada et al., 2004). In contrast, within the faster gaits and jumping, where the rider adopts a 'forward' position holding their body out of the seat and weight bearing through the legs (Roberts et al., 2009), increased metabolic cost and blood lactate levels are reported, suggesting some anaerobic demand is also present (Guiterrez Rincon et al., 1992; Roberts et al., 2009; Trowbridge et al., 1995). Therefore jumping appears to constitute an increased metabolic effort compared to riding on the flat which suggests that discipline-specific training would be beneficial to rider performance (Douglas et al., 2012). However this will depend on the fundamental fitness level of the rider, as an unfit individual will not be able to sustain their balance and strength riding on the flat for sustained period of time. Therefore it is important that all riders are aware of the metabolic cost of riding and that a lack of fitness could translate to a reduction in their strength, balance and stability (Douglas, 2015), potentially resulting in their injury and which is also likely to be detrimental to their horse's performance.

10. The physical influence of rider position

The complexity of equestrian sport is amplified by the need to consider the physical influence of the rider on the horse. To be efficient and successful in the chosen competitive discipline the correct position of the rider on the horse is required and accordingly 'if you sit better, you will ride better and your horse will go better' (Winfield, J., personal communication). Riding well is not only required for effectiveness and therefore performance outcome, but the basic position must be secure to prevent falls and subsequent injuries. The correct position is one where the rider's movements follow the movement of the horse in a harmonious manner (Terada et al., 2004) and the challenge to the rider is that each gait has different characteristics of movement of the equine spine (Licka et al., 2004a, 2004b, 2009; Johnson and Moore-Colyer, 2009; Byström et al., 2009, 2010). The saddle and the rider are positioned over this moving body and this movement will challenge the position of the rider and their balance. To maintain synchrony with the horse, the rider requires the ability to adapt to the motion patterns of each gait (Terada et al., 2004). Anecdotally a vertical line linking the ear-shoulder-hip-heel in the sagittal view is reported to be the ideal and correct position in many lay texts. To date the details as to why this position is beneficial and the link between this position and the performance of the horse has not been reported.

Rider position has been shown to be influenced by the skill level of the equestrian (Schils et al., 1993). Kinematic posture analysis of the advanced rider showed the upper body to be closest to the vertical during each gait carrying the upper arm ahead of the trunk, with the thigh and lower leg positioned under the body. The mean angle of the advanced rider's trunk angle in walk was greater than the beginner and this angle decreased further during sitting trot beginner riders who tilted the upper body forwards (Schils et al., 1993; Lovett et al., 2005). In canter the range of movement in the trunk is similar to that at walk (Lovett et al., 2005). This suggests that time, experience and training, by which the rider progresses towards becoming an expert, are valuable in achieving a more upright position.

Byström et al. (2009) further analysed the rider's movements during the gait, theorising how a correct posture works with the horse's locomotion. The findings suggested that as the horse decelerates as the rider is pressed against the saddle and stirrups, this causes the riders lumbar spine to hollow (extend), the legs joints flex with the head and feet moving forwards. During propulsion the rider is pushed out of the saddle, causing the lumbar spine to straighten (flex) and legs extend. In addition, the head and feet move backwards, this is presumed to be the effect of the horse transmitting through the rider. Experienced riders have demonstrated to be less phase-shifted in comparison to novice riders (Byström et al., 2009) and when compared with Schils et al. (1993) this may be a result of a more vertical trunk position. Lovett et al. (2005) analysed the pelvic positioning of inexperienced riders compared with more experienced riders who displayed a limb-torso angle of 140° compared to 128° of that of the novice riders tested. This difference in positioning may result in the reduced synchronicity with the horse's movement where the position is less shock absorbing and it results in the rider being more phase shifted through the horse locomotion (Byström et al., 2009). Expert riders maintain a more upright position despite the destabilising effect of the horse's movement and therefore are more in 'sync' with the movement of the horse. Potentially the impact of a novice rider on the horse could be greater than that of an expect rider. The asynchronous movement and altered body position may lead to negative physical impacts such as injury to the soft tissues under the saddle and/or increased strain on the structures in the horse spine and distal regions in an attempt to compensate for the unbalanced forces from the novice rider.

Problems within the rider position can have the potential to result in injury to the rider and a suggestion is that an asymmetry within the rider can be the origin (Kraft et al., 2007). Asymmetry of muscular activity in the back may induce spinal instability, which has potential to result in injury. The cause of muscular asymmetry has been linked to axial rotation (Kraft et al., 2007) although it is debatable whether injury could be the cause of the rotation and muscular asymmetry rather than the effect. Symes and Ellis (2009) investigated asymmetry in riders; the findings suggested that riders sit with their thoracic spine rotated most commonly to the left, with greater right shoulder displacement. It was demonstrated that there was chaotic movement is displayed by both the shoulders in right canter, whereas in left canter the right shoulder displays significantly more displacement, however the small number of riders in this trial may not be representative of the equestrian population as a whole. Although the range of competitive experience of the riders in this trial was large the group was examined as a whole and surprisingly all demonstrated an asymmetric rotation, which may be an explanation for the high percentage of riders with back pain (Kraft et al., 2007). Further exploration of the rotary component of the rider's position is needed. Byström et al. (2009) suggested that although the horse does dictate the rider's movements, the exact phasing and amplitude is related to the rider's functional skill level and individual physical characteristics, which may be also be factors in the data collected by Symes and Ellis (2009). However asymmetry in positioning and motion patterns of the rider may have a significant effect in equestrian sports that demand equal ability of the horse and rider to move in synchrony in specific movements, for example in dressage. The requirement in competitions, even at the most basic level is that the horse is able to travel in both directions equally, for instance have symmetrical lateral bend on the left circle to the right. This is not only relevant in dressage however as a show jumping horse may be required to turn into a jump from either direction then land and turn when moving away from a fence. If, as suggested, the position of the rider and their weight distribution effects the ability of the horse to bend, then the rider needs to be able to transfer weight and rotate in their body under neuromuscular control as required. At more advanced levels of dressage complex patterns of movement are required, which can only be achieved by skilled application of aids to the horse. An asymmetric or stiff rider is likely to have a negative effect on the achievement and quality of these movements.

The function of the rider's position whilst mounted is a result of the muscular activity and this has been studied using electromyography (EMG), demonstrating the role of the muscles in regards to maintaining posture (Terada et al., 2004). In the inexperienced rider, muscular activity is uncoordinated with the horse's locomotion, resulting in a tendency of riders to grip with the adductor magnus muscle in attempt to maintain their position. The gripping shown from novice riders' result in less stability in their position as well as decrease the potential or ability to remain synchronous with the horse's movement. The lack of suppleness and flexibility in a rider's position will limit transmission of force from the horses stride, potentially increasing the possibility of sustaining injury. In comparison, the experienced rider is able to coordinate the rectus abdominals and the erector spinae muscles with the horse's movement, demonstrating postural skill and therefore resulting in effective riding (Terada, 2000), defined as the ability to follow the movement of the horse in a harmonious manner Terada et al. (2004). Meyers and Sterling (2000) highlighted the importance of the abdominal muscles demonstrating that an increase of participant's abdominal strength can be displayed though the use of an 14 week equine intervention training programme, which could give greater muscular control during their riding. Potentially linking this training to the concept of core strength for the rider is as yet unproved. However, in the lay press exercises such as Pilates are frequently reported as being beneficial for the rider. In a review by Cruz-Ferreira et al. (2011) presented strong evidence to support the use of the Pilates method of exercise at the end of training to improve flexibility and dynamic balance and moderate evidence to enhance muscular endurance in healthy people. However in their comparison of the Pilates method with either no exercise or basic back exercises, this time for patients with chronic low back pain, Pereira et al. (2012) concluded that the Pilates method did not improve functionality or reduce pain in patients who have back pain. Both authors recommend that further investigation in required and this is a suggestion when applying the principles of this exercise format to improve riders' position. Encouraging results have been demonstrated in as study of ten female riders undertaking a six week course of Pilates. At the end of the exercise period all riders had less deviation from the vertical ear-shoulder-hip-heel line in walk, trot and canter (Boden et al., 2013) which validates the need for more investigation into this method of exercise and the benefits to riders'.

Terada et al. (2004) used EMG to further understand muscular activity of the rider measuring twelve upper body muscles of the rider, finding that this activity varied depending on the stride phase of the horse. EMG findings demonstrated that in the early stance, the trapezius displayed peak values, suggested to stabilise the rider's neck and scapular during the impact of the horse's diagonal limbs. In mid-stance, the rectus abdominus presented peak EMG activity; possibly to stabilise the trunk and enable the swinging of the pelvis in relation to the horse's motion. During the horse's stride cycle, the rider's pelvis was moved in accordance with the horse's locomotion, the shoulders moved in opposition and the elbow joints extended or flexed, resulting in the maintenance of rein contact with the bit. In an alternating manner at the beginning of stance, the biceps brachii was maximally active and in late stance the triceps brachii were most active, functioning to stabilise the rider's hands and maintain rein contact (Terada et al., 2004). As reported in the review by Douglas et al. (2012) the requirement for strength in the equestrian is uncertain and the research of Terada et al. (2004) and Terada et al. (2006) propose that muscular activity in the rider is to maintain postural control, such as contact with the bit and balance, rather than the production of power. Both studies corroborate reporting that experienced riders have an increased limb-torso angle, a more vertical posture of the trunk, a similar conclusion to Schils et al. (1993), Lovett et al. (2005) and Byström et al. (2009). The co-ordination of muscular activity and position is a sign of a skilled rider according to Terada et al. (2006) and this rider has a still hand and the ability to apply aids without it significantly affecting their position. The significance of a 'still hand' is in relation to the rein contact where high maximal tension and high loading rates may be damaging to intra-oral tissues and therefore have implications for equine welfare (Clayton et al., 2011).

The inability to maintain a good position on the horse and therefore adopting a posture that is less than ideal can increase muscular stress and may contribute to injury of the rider (Symes and Ellis, 2009; Hawson et al., 2010), however it is not only the effect on the rider but also the effect of the rider on the horse's kinematics and kinetics. With a rider mounted there is increased vertical ground reaction forces in the forelimbs as well as greater fetlock extension (Clayton et al., 1999) which the authors suggest is compensation for the presence of a rider and may lead to increase strain on the distal limb, especially the palmer soft tissues. Licka et al. (2004a,b) found that the presence of a rider can alter the degree of lameness which further highlights that the effect of the rider on the horse is one that requires adaptation by the horse. The concept of lameness created by the rider is not one that has yet been explored empirically. The term 'bridle lameness' is used by riders, trainers and those assessing lameness to describe a variable lameness that is seen during ridden exercise. However, whether the rider causes the un-level gait action or exacerbates an existing sub-clinical lameness requires further investigation and debate.

Optical motion capture is the current gold standard to assess three dimensional movement (Warner et al., 2010) however data collection is limited to line of sight from camera to markers fixed on the body. The result is data collected on repeats of low number stride cycles over ground or from gait performed on a treadmill which prevents simultaneous assessment of riders. An alternative is the use of inertial movement sensors mounted on the horse and/or the rider which could be used to assess movement outside gait laboratories (Greve and Dyson, 2013). Objective data collected by these small units have been shown to agree with data collected via motion capture (Warner et al., 2010) and therefore can be used to evaluate movements of the riders. Munz et al. (2013) investigated the pelvis rotation of two riders in different gaits under field conditions. Although differences were seen in the rider's movements, due to the sample size, no conclusions could have been drawn regarding the causes. However the methodology proved to be workable and repeatable suggesting further exploration of rider's movements could be undertaken with inertial movement sensors. Eckardt et al. (2014), Gandy et al. (2014) and Lee and Kwak (2014) have used suits worn by the rider that contain multiple inertial motion sensors and the future for more detailed examination of the rider and their movement on the horse looks very promising.

Asymmetry in the rider's position is considered a negative trait (Hobbs et al., 2014) as a good position is needed to ensure clear communication from the rider to the horse via clear physical signals (Symes and Ellis, 2009). Miscommunication could lead to conflict between horse and rider, at a minor level resulting in lack of attainment of the desired outcome but with conceivable progress to possible injury to either party. If a rider with an unstable or asymmetric position is not able to clearly communicate, via their aids, to the horse they may believe the horse does not understand their requirements of it. As suggested by Symes and Ellis (2009), the rider often progresses to unnecessary use of stronger bits or longer spurs in an attempt to get the horse to understand and respond. Randle (2015) agrees that the horse does not necessarily '*understand*' what he did wrong, rather the behaviours observed are simply a fundamental response to cues (stimuli, aids). The International Society for Equitation Science, in their 'First principles in Horse-Training (ISES, 2015) state that two overlapping or conflicting signals (aids) can be very confusing for the horse so it is essential that signals are applied in a manner that is consistent, in distinct areas that are independent of/from one another. Further to this the ISES principles states that for a habit to form, for instance a particular required movement of the horse, the learned response must be an exact copy of previous responses which can only be possible with clear, non-confusing and consistent application of the aids by the rider. Therefore it is the rider's responsibility to maintain a good position and deliver clear signals, by absorbing the movement of their horse whilst their balance is challenged by the destabilising forces of the movement, to be able to promote understanding and progress the training of their equine partner.

11. Equine management and rider decision making

Decisions made by the rider can exert a positive or negative influence upon the horse's behaviour through their actions, therefore effective decision making is a key requirement of advanced equitation practice advocated in the ISES mission statement (ISES, 2015). The application of rider aids, balance and coordination control the horse's gait, speed, and direction, and define the exercise being undertaken; at the same time the rider will need to be making judgements in response to cues from the environment and/or the horse, and adapting their actions appropriately (Rivera et al., 2002). Decision-making during riding may require experience to guide the rider to make informed choices for example judging if a horse is safe in traffic or if a horse is fit enough to compete, and poor decisions could place the inexperienced or leisure rider at risk if they are not supported by an experienced peer or coach. Similarly rider management of their own health can impact on their riding efficacy, for example increased caffeine ingestion can enhance short-term cognitive function in athletes (Sokmen et al., 2008) and as little as one night's sleep deprivation can reduce reaction time (Cain et al., 2011) which could impact decision making or an individual's physical ability.

Additionally, riders may also be the owner or trainer of horses in their care; therefore they have additional responsibilities including selection of suitable tack and equipment which fits the horse correctly preventing pain (Hawson et al., 2013; McGreevy et al., 2012; Nicol et al., 2014) and making informed management decisions to optimise the horse's health, welfare and capacity to perform its role (Hemsworth et al., 2015; McLean and McGreevy, 2010b). Stable management decisions have the potential to create cues which could influence equine behaviour (Rivera et al., 2002) and can also impact the horse's physiology and performance (Williams, 2013). Restricted forage and concentrate-rich feeding regimes are thought to lead to gastric ulceration (Andrews et al., 2006) whilst overfeeding may result in excessive energy which could influence ridden behaviour (McGreevy and McLean, 2010). A number of recent studies (for example Robin et al., 2014; Owers and Chubbock, 2013) have reported an increasing trend for obesity in leisure horses which is not recognised by horse owners or riders (Hemsworth et al., 2015). Unfortunately many owners and riders do not recognise the potential detrimental impact of equine obesity on their horses' health and welfare (Owers and Chubbock, 2013). BCS is a measure of a horse's bodyweight and condition which can provide an indication of a horse's welfare status (Hemsworth et al., 2015) and which is reported to be commonly misunderstood and underestimated by riders (Ireland et al., 2011). Therefore it could be considered important that the leisure and amateur rider understand how to apply body condition scoring (BCS) to assess their horse's weight and what an 'ideal' BCS should be for the expected workload of their horse (Carroll and Huntingdon, 1988). Supporting riders through education and building their experience to facilitate accurate BCS could help maintain optimum weight in their horses (Owers and Chubbock, 2013) thus preventing additional stress (due to excess weight) increasing the biomechanical and physiological demands of exercise.

Socio-economic factors can influence participation and decision making in sport (Downward, 2007) and influence management decisions affecting equine welfare (Hemsworth et al., 2015). For the professional rider financial incentives, owner opinion, maintaining their reputation, competitive success and qualification or selection pressures can influence decision making and potentially result in actions from the riders which reduce the emphasis on the horse's health and welfare in the pursuit of success (Parkin and Rossdale, 2006). Factors which can affect the amateur or leisure rider could arise from peer pressure, financial constraints, juggling family, work and equine commitments, knowledge and experience, their support network, coach and their relationship with their horse. Substantial evidence exists to suggest that spectators and recreational participants in sport view high-profile professional athletes as role models (Mutter and Pawlowski, 2014). In equestrianism, role model status tends to focus on riders and their horses as individual athletes or partnerships, rather than mimicking management regimes, as traditionally training and management systems used to promote successful equine athletes are generally not disseminated. Role models can generate fashionable trends within equestrianism evidenced by the range of celebrity rider endorsements for horse and rider equipment and clothing ranges. Trends may take the form of items of tack and equipment e.g. a certain type and brand of boot or bit, or a training method perceived to be related to role-models' success (Mutter and Pawlowski, 2014). Such trends can be detrimental to equine (and human) welfare if the mimic does not possess the skill or experience of the professional rider and does not understand how to fit or use the equipment safely and correctly, or possess the skill, experience or understanding to perform selected exercises. For example, a poorly fitted bit can result in dental pathology (McGreevy et al., 2011) and unwanted behaviours during riding (McLean and McGreevy, 2010a) whilst persistent and forced application of hyperflexion could be used in training by the uneducated rider resulting in unintentional negative welfare for the horse (McLean and McGreevy, 2010b).

12. Rider recognition of back pain and injury in the ridden horse

If the rider is considered to be a factor in the formation of back pain in horses then an understanding of the significance of pathology to this region is essential. Equine back pain is a significant welfare concern for ridden horses, and the ability of the rider to recognise the symptoms and to prevent injury through sound management is key for good welfare. Murray et al. (2010) reported that 40% of 11363 dressage horse owners surveyed in the UK, responded that their horse had experienced a back problem at some time during their ridden career. These numbers represent a significantly high proportion of horses that are suffering injury in the course of their equestrian discipline. A horse with back pain may present with one or more clinical signs, such as altered gait, pain on palpation of the spinal region or restricted spinal range of movement. They may also present with behaviour signs such as reduced willingness to be mounted, changes in behaviour such as napping, bucking, rearing, bolting, resistance to the aids, refusing to jump or more subtle signs such as tail swishing or teeth grinding whilst apparently performing as required. These behaviours, which are undesirable behaviours to the rider, can be displayed in any order, and in any combination when under saddle (McGreevy and McLean, 2005). Equine back pain can also be caused by problems distinct from the equine spine, i.e. pain referred from another non-spine source. Many horses showing back pain also have co-existent hind limb lameness, the most common being bilateral arthritis of the distal tarsal joints or bone spavin (Marks, 1999).

Riders and keepers of horses should be able to recognise the behavioural and clinical signs associated with back pain. Erichsen et al. (2004) comments that some horses perform well when they have radiographic and/or scintigraphic findings, others do not and it is not completely understood why some horses show signs of pain. A mild lameness would lead a horse to slightly alter its gait pattern without it being visible to the human observer, so called 'sub clinical'. Even when lameness is visible to the observer there is reportedly only low agreement on the amount and the limb it is observed in (Keegan et al., 2010). Altered movement and back pain secondary to the lameness may lead to alterations in the epaxial muscle function (Gomez-Alvarez et al., 2007, 2008) and subsequently how the horse responds to training and performance when ridden. Using video recordings of thirteen horses with varying degrees of mild lameness, ridden by both experienced and inexperienced riders, Marqués et al. (2014) measured the effect of rider experience and evaluator expertise on lameness grading. They found that rider experience did not impact on the lameness scores in either the sound or unsound horses although with the small sample size the variability in the riders may not have been significant as this contradicts a previous study with 20 horses and two riders at different training levels, where the presence of a rider altered the degree of the lameness (Licka et al., 2004a, 2004b). This suggests a greater body of research is required to verify the effect of the rider on lameness presentation and to ascertain different riders' abilities to recognise a lame horse during riding.

The addition of weight to the thoracolumbar spine induces extension, or 'hollowing' of the spine (de Cocq et al., 2004) and whilst this study used a passive weight rather than a human on the horses' back the resulting extended spinal posture would be expected with a rider on board. Horse that were unridden but had clinical signs of back pain also have a more extended spinal posture during walk and trot (Wennerstrand et al., 2004). The top of the dorsal spinous processes approximate when the thoracolumbar spine is extended (Berner et al., 2012; de Cocq et al., 2004), narrowing the interspinous space and potentially allowing the processes to touch. Therefore thoracolumbar extension is clinically significant in the presence of pathology such as close, impinging and overriding dorsal spinous processes (kissing spines) in the thoracolumbar spine. A strong relationship between the presence of osseous changes, which may be accompanied by epaxial muscle atrophy, and back pain is suggested (Walmsley et al., 2002; Zimmerman et al., 2012).

Back pain may also be caused by a poorly fitting saddle and has been discussed as another cause of atrophy or asymmetry in epaxial muscle mass. The epaxial group of muscles are those that have an origin and insertion above, dorsal to, the spine in the quadruped animal. Obvious physical signs of long term incorrect fitting of a saddle include: white hairs, sores, local inflammation and muscle atrophy in the withers (Gellman, 1998). Temporary swellings after removing the saddle, scars, and hard spots in the muscle, in addition to the atrophy of the muscles on either side of the withers may be present after only a short exposure to an incorrectly fitting saddle (Harman, 1999), but in the early stages, all horses experiencing discomfort and pain will show various behavioural responses. Despite the perceived significance of the saddle as a cause of pain in the ridden horse a recent review found that there is a lack of scientific data that investigates the impact of saddle fitting both on the horse and the rider (Greve and Dyson, 2013). If it is suggested that the saddle fit and rider may cause exacerbation of thoracolumbar region pain and/or lameness, then this relationship should be a priority for further investigation.

Back pain and diseases of the spine are considered significant problems in both equine sports and veterinary medicine (Peham et al., 2001). Denoix (1998) stated that in horses, back pain is a major cause of poor performance and gait abnormalities although the definitive diagnosis of the cause of the pain remains a real challenge. More recently Stubbs et al. (2010) also concluded that the relationship between pain, pathology and spinal function has still not been clearly established in horses. Understanding the aetiology will allow the causative factors to be addressed, reducing the occurrence of back pain resulting in a positive impact on the horse welfare.

Constant evaluation of horse gait for signs of lameness and pain should be part of the day to day management by those involved with the horses. It is the obligation of those responsible to take appropriate action when concerns are raised. The duty of care should be shared by horse owners, trainers and riders. It is not acceptable to consider that bad behaviour is perhaps a personality issue of the horse or due to some outside influence and those managing the horse are obligated to seek advice to exclude the presence of pain as a cause of the behaviours exhibited. If back pain is deemed to be the source of pain in the horse, the rider may be culpable and therefore examination of the horse should include analysis of the rider as part of the equation.

13. Performance analysis: a tool to improve horse welfare in equitation?

Not only can analysis of performance be advantageous to achieving sporting achievement (Williams, 2013) but it could also be applied to improve the leisure rider's relationship with their horse. Performance analysis is becoming more accessible to all levels of rider with the development of wireless technology linked to smart phone applications and video capture which can be used to analyse training or competition performances (McGarry, 2009; Williams, 2013). Performance analysis relies on the objective assessment of data or key information sets related to training and/or competition, to improve athletic performance but requires some degree of expertise from the assessor to prove worthwhile (Hughes and Bartlett, 2002). However, simple but effective tools such as goal setting and periodization (planning ahead) (Hughes and Bartlett, 2002) can be adopted by the rider to outline future development plans for them and their horse, linked to targets which may be competitive (for example completing a 1.20 m show jumping competition) or personal (for example hacking out alone). For advanced analysis, commercial technology systems and professional support are available to facilitate analysis of equine gait, the quality of specific movements or jumping, fitness, rider position and competition performance (Douglas, 2015; Pfau, 2015; Williams, 2013). The inexperienced rider should also be encouraged to utilise their coach to support their development by providing an experienced mentor to reflect on progress and suggest training plans and exercise to stimulate improvement. Performance analysis in equestrianism is complicated by the inclusion of the horse, a separate sentient being which can also influence the success of the end performance (Visser et al., 2008). Engaging with performance analysis has the added benefit of developing reflective skills in the athlete (Hughes and Bartlett, 2002) therefore the process has the potential to progress the horse and rider relationship forward, as the rider becomes more aware of their impact (riding and via management choices) upon the horse, providing the (informed) rider with a tool to improve their equitation skills.

14. Conclusion

The horse-rider relationship is a complex phenomenon. The inability of the horse to verbalise its emotions and pain places significant responsibility on the rider to ensure the animal's health and welfare is optimised through informed management and riding. An increased understanding of the complexity of the horse and rider partnership, through education of the rider and scientifically informed training, could facilitate enhanced performance, promote equine health and welfare and create happy and successful horse-rider partnerships.

Conflict of interest

None.

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