COMPARISON OF BEHAVIOUR EXHIBITED BY HORSES RIDDEN IN CONVENTIONAL BITTED AND BITLESS BRIDLES

By

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Rose Margaret Scofield

Comparison of Behaviour Exhibited by Horses Ridden in Conventional Bitted and Bitless Bridles

Abstract

The bitless bridle has been advocated as an alternative to traditional bitted bridles in many equestrian disciplines in order to avoid bit injury and distress that has been reported in previous research. Anecdotal observations and lay publications suggest that the bitless bridle has become very popular amongst riders and horse owners in the United Kingdom. The bitless bridle has been compared favourably to the use of the bit in foundation training with improved performance in bridling, long-reining and riding reported for some horses in the bitless sample group. Similarly, improved dressage test scores and comments by a judge have been attributed to the use of the bitless bridle with a comparison of tests ridden in a bitted and bitless bridle one after the other. However objective data do not exist on the alternative use of bitless bridles by leisure riders for the majority of horses in the UK, used primarily for hacking, local shows and riding club purposes. The aim of this study was to compare the behaviours exhibited by leisure horses whilst wearing the bitless bridle with those shown when ridden in the usual bitted bridle. A second qualitative study involved the collection of data from a specifically designed questionnaire to obtain an understanding of the term leisure rider. The quantitative study entailed 12 subjects randomly selected from a population of privately- and college- owned horses which were ridden by a single qualified rider in the Preliminary 4 British Dressage test in their usual bitted bridle and

bit and in the Dr Cook™ brand Beta Bitless Bridle. All tests were videoed continuously allowing the subsequent instantaneous recording of behaviour. An ethogram developed specifically for the study was used to collate identified conflict behaviours exhibited by the horse. Assessment of pilot data demonstrated that six different conflict behaviours occur with both types of bridle (tail swish, open mouth, cow kick, hollow, fall out and pull down). The frequency of each behaviour was recorded, along with the total number of behaviours exhibited (Behavioural Intensity) for both conditions. Whilst a similar amount of conflict behavioural activity was observed with both bridle types, significantly more tail swishing was observed with the bitless bridle (median occurrence/test =3.00; range 0-37) than with the bitted bridle (median occurrence/test =2; range 0-23; Wilcoxon T_{12}=1.00; $P<0.05$).

Key words: equid, behaviour, welfare, bitless, bridle, bit, conflict.

Contents

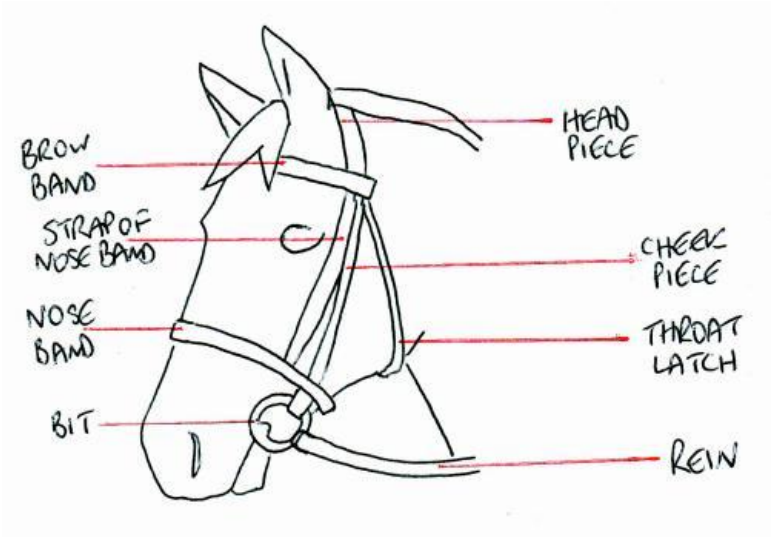
Introduction

Horses are thought to have been domesticated around five to six thousand years ago by nomadic tribes living on the steppes of Eurasia (Edwards 1987). The timing of the first use of bridle regardless of type (i.e. bitted or bitless) on a horse is not known, though bits specifically are mentioned in the use of chariot horses around 1360 BC and later in ridden horses by Celtic tribes living in Northern Europe (Edwards 1987). Over the time since the horse has been domesticated the design of the bridle has changed dramatically, with variations due to ease of use, fashion and the materials available. The different equestrian disciplines have also played a part, with the competitive sport of dressage requiring strict rulings regarding the type of bridles able to be used at each stage of progression (German National Equestrian Federation 1997).

Competitive dressage in the United Kingdom today demands the use of a bit in a horse's bridle (British Dressage 2011) and rules relating to dressage agreed by the Fédération Équestre Internationale give statements of fact regarding the many different types of bit allowed (Fédération Équestre Internationale 2011). As a form of contact between rider and horse the bridle is an extremely useful tool, and well trained communication through this contact is linked with success in dressage (McDonald & Warren-Smith 2008). The bit as a tool enables the rider to have a physical connection with the horse through the reins. The communication is accomplished through this connection, where the bit is used to ask for behaviour by delivering a stimulus to the horse. The basic bridle consists of various straps of leather or synthetic fabric, designed and arranged in multiple ways depending on its use, the

rider's preference or adherence to the rules and regulations of the sport they are taking part in. Generally a bridle (see diagram 1) will have straps running from the bit where it rests in the mouth on the diastema behind the ear and over the top section of the head (colloquially named the poll) and vertically across the mandible to the other side of the bit. This part consists of cheek pieces, which attach to the bit and then buckle halfway up the cheek to the headpiece that runs over the poll. The headpiece splits into two just below the poll and joins onto the throatlatch strap. The throatlatch strap runs vertically parallel to the headpiece and fastens over the upper and lower anterior mandible. Just below the ears is a brow band that straps horizontally across the front of the horse's forehead and encloses both ends of the headpiece. Bridles also often have a noseband, which is an independent piece of strapping that encloses the muzzle horizontally with a buckle or other fitment and then has vertical straps that again run parallel to the cheek pieces and through the ends of the brow band to lie on the poll below the headpiece. The bit is held in the mouth by pressure from the cheek pieces, headpiece, brow band and throatlatch. When riders progress through the stages of dressage competition various different bridles have to be used, including the double bridle, which comprises a further array of strapping that is designed to support, position and hold two separate bits in the horse's mouth.

Figure 1 – Parts of the bridle

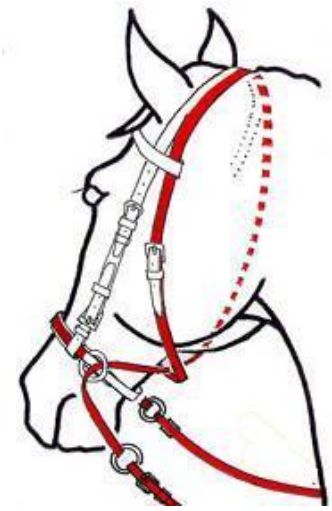


The bitless bridle is a variation of the bitted bridle that does not utilise the action of a bit. It probably originated in North America, where a bridle without a bit was used by Native Americans (Edwards 1987). These types of bitless bridle used by the Native Americans, and indeed by settlers, and have filtered through to modern day riding, maybe with the advent of the ideals of natural horsemanship imitating the history of horses in North America. Natural horsemanship has been defined as horse training using the theory that a human can adopt the position of leader in the horse-human dyad and then use communication based on equid body language (McGreevy & McLean 2010). Each type of bitless bridle works on the mechanical principle of a lever, where force is increased by use of a pivot (Preuschoft *et al.* 1999). The presence of bits

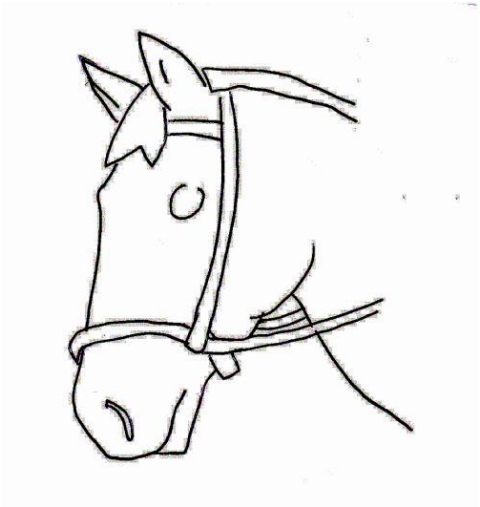
in bridles also work on the principle of the lever, with the pivot being the bar of the bit that rests on the diastema.

Like the basic bridle that is designed to carry a bit, the bitless bridle has a brow band, headpiece and throatlatch, though the cheek pieces are omitted. Instead of the bit, different designs of noseband are used to apply pressure to the muzzle (see Diagram 2). Nosebands fixing underneath the mandible provide leverage instead of the bit in the mouth (Edwards 1987). Varied designs include the Dr Cook™ Bitless Bridle, which works on a concept of a figure of eight noseband that crosses under the mandible and applies pressure not just on the muzzle but also the cheeks and poll (Cook & Mills 2009). Another design is the sidepull, which works on a fixed noseband with the reins attached directly to the edges of this noseband. The bosal works by putting pressure on the nose through a single attachment, and the hackamore, which acts solely with pressure on the nose sometimes incorporating long metal shanks to which the reins are attached to increase leverage. Generally reins would attach directly to the bit rings in a bitted bridle, or in various combinations to the end of straps attached to the noseband in a bitless bridle. The action of a bridle, bitted or bitless, relies on negative reinforcement in pressure-release to train the horse to stop when asked by releasing this pressure.

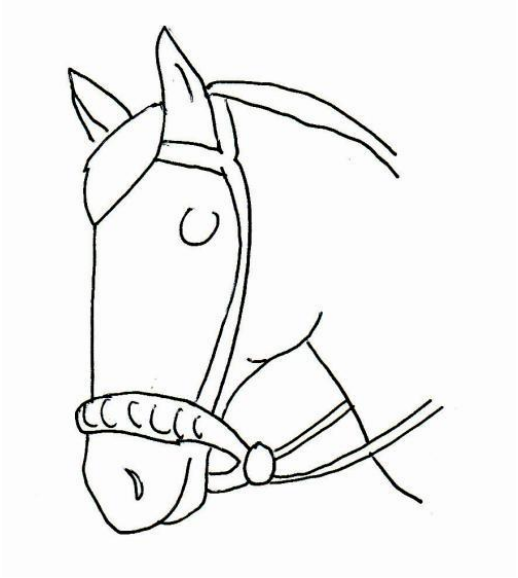
Figure 2 – Types of bitless bridle



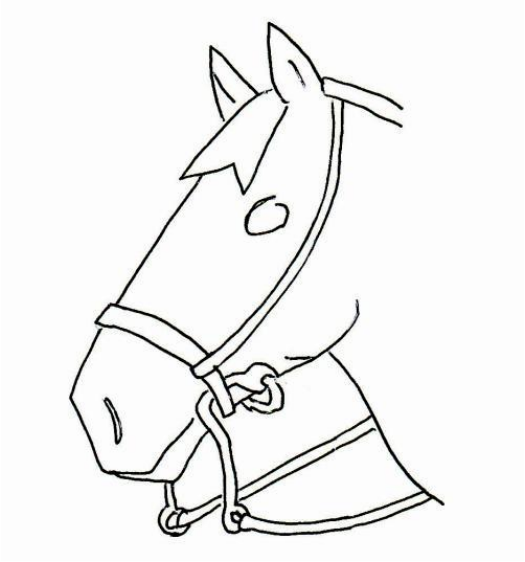
Dr Cook™ Beta Bitless Bridle
(taken from www.bitlessbridle.co.uk)



Sidepull bitless bridle



Bosal bitless bridle



Hackamore bitless bridle

The anatomy of the horse's mouth must be taken into account when studying bitted and bitless bridles. Studies into welfare issues of injury and damage to the area need to acknowledge the function of this biological structure. The horse has a long branched jaw, with the diastema situated between the premolar teeth and the canines on each side, which is known by equestrian practitioners colloquially as the bars of the mouth (Heuschmann 2007). The diastema is covered by gingival mucosal tissue and it is on this structure that the bit in a bridle rests. When pressure is applied to the reins it can cause the bit to fall against the teeth. The diastema has an extensive blood and nerve supply and can be easily bruised (Quick & Warren-Smith 2008). In a double bridle, both bits lie on the diastema, with each bit having its own set of reins that should be used by the rider independently to communicate to the horse which school movement they are signalling them to perform (Cave 1996) when pressure is applied to the reins causing the bit to fall against the teeth.

Different items of saddlery have been invented to improve this communication and in some instances biological procedures have even been promoted. Many equine dentists perform what is known as the process of creating a 'bit seat', where 'rolling' is applied to the anterior edge of the upper and lower premolars in order to allow the bit to rest in a more comfortable position. The rolling consists of removing a varied amount of the anterior edge of the upper and lower premolars with an electric dental rasp. It is believed to allow more space for the cheek to bulge away from the surfaces of the premolars when the horse is being ridden, due to the removal of the edges of the premolars. However, there appears to be a lack of research on the efficacy or indeed regarding any welfare issues with the placement of bit seats into a horse's premolars. Popular magazines still frequently report the possible positive and negative

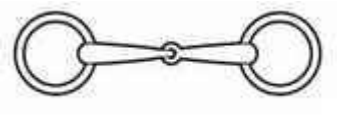
considerations of using bit seats, with no consensus on the effect of the practice to the ridden horse.

The condition that some horses experience referred to by its observable outcome of 'head-shaking' has been attributed to pressure on the diastema by the bit. This is a condition developed by mature horses with the reported clinical signs of rubbing and flicking the muzzle up and down and acting as if it is being attacked by a flying insect (Madigan & Bell 1998). Research by use of a questionnaire has been carried out to determine if the use of a bitless bridle might alleviate the symptoms of head-shaking (Taylor *et al.* 2003). Some improvement was observed when the horse suffering from this condition was ridden in a bitless bridle, suggesting that pressure in the mouth or on the outside of the muzzle may have been a contributing factor in this particular case. Further research evaluating a population of headshaking horses might suggest that the horse reported in this case may have been an exception.

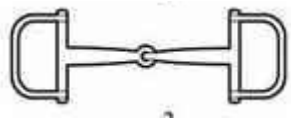
The British Dressage Rules (2011) allow a variety of bit types to be used under their competitions. The number of bits can be categorised into different types depending on their action and appearance, and bits may have a combination or a single feature of these descriptions (see Figure 3). These include eggbutt (fixed mouthpiece), loose (moveable mouthpiece), French-link (mouthpiece includes an angled middle section), lozenge (mouthpiece includes a straight middle section), straight bar (plain bar with no joints) and jointed (mouthpiece with a single joint in the middle). Much of the information regarding these bits present only anecdotal evidence of their efficacy, and many of these types of bits are advertised to help with particular problems that the rider or trainer may experience. For example, a single jointed mouthpiece is thought to

use a ‘nutcracker’ action, where the single joint puts pressure onto the tongue in a very small area as the outer rings of the bit are pulled towards each other by the action of the reins. Jointed bits that employ a lozenge are thought to reduce this effect by using extra joints at each end of the lozenge section in the mouth thus giving a larger surface area. A straight bar bit will not have any ‘nutcracker’ action at all, because the straight bar does not allow the rings to be pulled toward each other. The lozenge bit, with an extra section that reduces pressure, was invented to improve the action of the French Link as it lies flat on the horse’s tongue rather than vertically pressing into the tongue.

Figure 3 – Types of bit

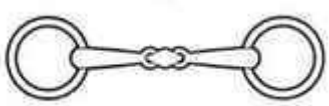


Loose ring jointed snaffle



Eggbutt jointed snaffle

Loose ring straight bar



Loose ring lozenge

Loose ring French Link

Like the use of various sorts of sport related equipment, choice of bit may be influenced by marketing campaigns and the use of certain items by highly regarded practitioners. Leisure riders may well be subject to the influences of these professionals. These phases of fashion have played a large part in the evolution of the bridle, and indeed still do (Huntingdon *et al.* 2004). It is questionable whether the welfare of the horse is considered when choosing a bit as perhaps the retailer concentrates on the effectiveness of the bit in providing control of their horse rather than the possibility of injury to the horse's mouth. It would make sense for effectiveness to be advertised above welfare due to the leisure rider demanding a quick result for removing unwanted behaviour displayed by their horse. For example, the Sprenger™ is a popular type of bit that is advertised on one website as being subject to research carried out on its efficacy, although this cannot be traced (The Saddlery Shop 2011). Sprenger™ are credited with the invention of a mix of metals and elements known as Aurigan™, which is patented by the company and contains a mixture of silicon, copper and zinc. Bits made of this metal are promoted as encouraging the horse to salivate, anecdotally believed to possibly make the mouth more responsive to the rider's cues. The dilemma to the leisure rider is illustrated by the expense of this type of bit, where the manufacturer advertises that it will improve the action of the horse, but its cost might well be prohibitive to the leisure rider.

The presence of a bit in the horse's mouth has been reported to increase this salivation, but also to have an effect on the ability of the horse to swallow (Manfredi *et al.* 2005). Certain types of bits were found to inhibit swallowing more than others (Manfredi *et al*. 2005). The subject of swallowing and salivation has been a concern for the equestrian world since publication in the popular press of photographs showing

competitive dressage riders using different training methods and of a particular report of a horse showing blood restriction to its tongue in a video gaining much attention on website forums. The overproduction of saliva has been shown in anecdotal reports to be particularly related to the use of the Rollkür training method where the horse is held in by the rider's pressure on the reins causing it to lower its head until it touches its chest, and therefore anecdotally believed to restrict the ability of the horse to be able to swallow the saliva created. This training method involves the rider manually forcing the head of the horse into its chest, causing the neck to over flex and bend at the second vertebrae, and in some cases for the chin to touch the chest (Heuschmann 2007). The method, also called 'low and deep' (Oldruitenborgh-Oosterbann *et al.* 2006) is employed to encourage the development of muscles in the neck enabling the horse to carry its head in the preferred manner as described by the British Dressage Rulebook 2011. Research has been undertaken to assess if this method of training does impact on the welfare of the horse (McGreevy 2007), and its interpretation as behaviour (Van Dierendonck *et al.* 2010). Interestingly, the organisation that sets the rules for worldwide equestrian sport, the Federation Equestre Internationale, have already stated that the training method cannot be used in the warm-up stage before a competition (White 2010). Diagrams have also appeared showing a human in the assumed Rollkür position, and manufacturers of bitless bridles have used this anthropomorphic image of a human in a painful position to illustrate why riders should chose a bitless bridle. There is a fundamental problem with using this pair of images because of the completely different anatomical structure of a quadruped equid skeleton compared to a biped human skeleton. The diagram of the human in Rollkür position does not take into account the obvious differences in balance or neck length.

In their comparison of the placement and positioning of six different types of bit, Manfredi *et al*. (2007) found that there were differences in the positioning with the single-jointed bits moving more freely in the mouth therefore possibly demonstrating their ability to cause injuries. Single-jointed bits are used in the preliminary stages of dressage tests where novice riders start their careers in this discipline. There might be cause for concern due to excessive movement of the bit as demonstrated, however the fact that the single-jointed bits moved more in the mouth might suggest the lessening of pressure concentrated on just one area of the diastema. Therefore the research may illustrate that the single jointed bit is actually better for novice riders to use due to this movement, and corroborate the rulings of British Dressage in this discipline.

It has also been reported anecdotally that novice riders can have a substantial impact on the locomotion of the horse and may cause unwanted effects on the horse they are riding. However Powers and Kavanagh (2005) demonstrated that novice riders had a non-significant effect when the stride kinematics of jumping horses were compared with those seen when the horses were ridden by experienced riders. Conversely, a study involving lame horses reported that the severity of lameness increased significantly with experienced riders but decreased with novice riders (Licka *et al.* 2004). It might be expected that experienced riders would affect a lame horse in a positive manner, having the ability to ride the horse differently in order to lessen the perception of lameness. There is also an issue to answer regarding research where the welfare of the horse is subject to questionable ethics, such as deliberately using lame horses in an experimental situation. Even if disregarding the methods used because of

the moral aspects of using injured animals in experiments, the reported results may be clouded by the differing effects of pain and injury felt by the horses whilst ridden.

Another effect reported the differences in novice and experienced riders where the result stated by Lagarde *et al.* (2005) described the synchronisation between horse and rider pairs in stride patterns as being significantly more stable with experienced riders than those pairings with a novice rider. This study compares unfavourably with reports published by Licka *et al*. (2004) as discussed above, although it must be noted that the sample size in the synchronisation report was n=2. However this reported existence of more stable synchronisation between the experienced rider and horse combination is interesting as it might appear that with an injured horse it would be expected to see an improvement with this dyad. Though if the experienced rider was immediately aware there was lameness, or indeed was aware at the start of the experiment, the rider could be expected to alter their position dramatically to avoid further injury to the horse, even if this actually caused the horse to appear lamer in its stride pattern.

There still seems to be no definitive description of a novice or indeed comparison with a leisure rider in literature although in the report by Lagarde *et al.* (2005) the novice rider is described as:

"…a hobby rider who occasionally practises dressage at a lower level."

As there appears to be a lack of definition of what a novice rider is, or a leisure rider, there is also a need for this to be investigated, especially as it does appear that novice riders do have some sort of measurable effect on horses in comparison to experienced

riders when assessed under experimental conditions. The reasons behind this difference need to be addressed in future research to ensure that what might work for experienced riders will also be useful to novice riders and in the case of bits perhaps also address aspects of welfare.

It is reported that natural horsemanship developed out of dislike of the methods in which horses were trained to be ridden in North America (Kiley-Worthington 2004). The methods of horse training used in North America were based around submission from the horse and dominance from the human, and various methods were employed such as the 'wheat-box' where the horse was immersed in cereal so it could not move and only then mounted (McLean 2003). Natural horsemanship was anecdotally mentioned in the displays of training by Monty Roberts, who stated he rebelled against the methods his father used to train their horses (Roberts 1997). The different aspects of the use of the bridle and indeed the bit itself have been widely reported in non-peer reviewed equine related magazines, websites and books with the advent of these ideals of what are collectively known as 'natural horsemanship'. Horses used for rodeos and other western sports were brutalised in their training to make them submissive to the rider (McLean 2003), and this was seen by many as cruel and unnecessary. As the idea of this new way of training developed, many practitioners of the methods arose each with their own way of handling horses (Goodwin *et al.* 2008). This has consequently led to many different emerging theories that have become successful and indeed have made money by introducing pseudo-scientific terms to the general horse-owning public (McGreevy 2004; Randle 2005 and Randle 2006).

The bitless bridle has been the subject of evolution by practitioners of natural horsemanship, namely around the anecdotal belief that the metal bit used in riding is unnatural and does not need to be utilised. In research bits have been found to cause problems in the mouth, such as increased ulceration (Tell *et al.* 2008), facial neuralgia (Cook 2003) and wear and damage to the teeth due to positioning of the device (Dixon *et al.* 1999). However this could be argued by the continued use of the bitted bridle in every discipline, and also among leisure riders, who may dismiss experimenting with a bitless bridle because of the possibility that a bit gives a rider more control. However, due to the popularity of bitless bridles in natural horsemanship, they have appeared as a growing trend throughout the equestrian world, although very little research concerning these items has been carried out to confirm to the riders of today if there is welfare benefit using them on their horses compared to the use of a bitted bridle.

The only previous ridden research using the Dr Cook™ Bitless Bridle utilised a sample size of four horses each ridden by their owner, with a criterion that they had all passed a level of horsemanship classified by United States of America (USA) tests (Cook & Mills 2009). The riders were videoed first while riding their horses in their own bridle in a simple ridden test and second in the Dr Cook™ bridle in the same ridden test. The two separate tests were each marked by an American dressage judge as they were ridden, and the results of the study were published in the full paper in 2009.

The preliminary research carried out by Cook and Mills (2009) investigated comparisons between a bitless bridle designed by one of the authors to a standard snaffle bitted bridle. The design of this bitless bridle is different to other bitless bridles, having two straps that cross under the head of the horse to apply pressure to the

whole head in varying degrees when a contact is made through the reins by the rider. The research detailed that the four horses were ridden firstly in their normal bitted bridle and then in a bitless cross under bridle of Cook's design. The experienced American dressage judge commented on the tests ridden, and data were collated using these subjective remarks along with a video of each test. When viewing these videos it can be quickly ascertained by the tone of her voice that the judge has some bias in recording the bitless tests favourably. Bias can be considered to have an effect on the reporting, as it is defined by a positive or negative opinion concerning a group or individual that is considered to be unfair (Oxford University Press 2012).

The research reported that each horse adapted quickly to the use of the cross under bridle, and statistically their tests improved with its use. However, there are issues with the research itself, where the author is using his own product with possible promotion of sales being a contributing factor to the results of the research. Another aspect of the experiment included the sample size, where only four subject horses were ridden in the tests. These horses were also ridden by their usual riders, and not a single rider, therefore compounding the situation where different riders may skew the results with lack of continuity, diverse riding ability and knowledge of their own horse. Also, the design of the research did not employ a crossover comparison of bitted and bitless bridles but instructed each rider to ride first in the original bitted bridle, and then the bitless bridle. Factors such as a horse suddenly having no bit in their mouth and perhaps a heavier touch on the reins due to rider insecurity could all add to render the results obtained of little use, and so therefore unusable.

Before the Dr Cook™ research concerning the cross under bridle, only one study had been carried out comparing the difference between a bitted bridle and a bitless bridle. Two cohorts of two year old horses received foundation training, one group in bitted bridles and the other in bitless bridles (Quick & Warren-Smith 2009). The foundation training consisted of bridling, where the horse is habituated to wearing a bridle, long reining, where the horse is trained to walk or trot in front of a trainer and controlled by two long ropes attached to each side of the bit, and riding. The group trained in the bitless bridles exhibited similar heart rate responses as the bitted group though in some cases also displayed a lower heart rate variability, possibly linked to a lower stress rate overall . Another study reported that the actual presence of a bit did not affect the behaviour exhibited by individuals in a cohort of horses until the reins were put under tension (Manfredi *et al.* 2009), therefore illustrating the possibility that it may well be rein tension causing problems rather than the bit.

The concept of learning theory regarding equines and equine training is defined in the International Society for Equitation Science (ISES) Eight Principles (www.equitationscience.com 2013), where the First Principle gives an outline of the description of learning theory as an explanation of using positive and negative reinforcement in training equines and habituating them to respond to stimuli given by the rider or trainer. The Eight Principles are based on a report by McGreevy and McLean (2007) where learning theory in equitation training was explored.

What is known anecdotally as traditional breaking uses parts of learning theory in all stages of a horse's education, and in particular in situations such as bridle habituation. Desensitisation is used where the horse is introduced slowly to the various

components of the bridle before experiencing the bit in their mouth for the first time. Habituation plays a part where the routine placing of the bit and bridle on the horse at regular intervals after desensitisation enables the trainer to have an animal ready to progress in their training. Learning theory may encourage the use of ground work before mounting a rider, and methods such as lungeing, long-reining and free schooling may be incorporated so the horse learns to respond to stop and go signals before it has the complication of a rider on its back. The bridle and bit help in this stage of training by providing the trainer with a stimulus easily applied to the animal from a safe distance while using a lunge line, where horses can then be free to express excited behaviour while habituating to the different pressures they are subjected to. The bit itself operates by applying pressure on the diastema of the mouth when the rider or trainer applies tension to the reins or lunge line/s, along with added pressure from the noseband and headpiece depending on which type of bridle the horse is wearing. The very basic controls of left, right and stop are communicated to the horse by applying tension and then releasing it when the horse performs the required behaviour.

The existence of many numerous levels of training from basic signals to advanced dressage movements all incorporate varied and in some cases very sensitive use of tension and pressure. Diverse types of bridle, bit and reins have mixed effects on the horse and its training along with rider variability including their different styles, education and experience. All these differences can lead to copious effects on the horse and its behaviour, and rein tension in particular has been investigated thoroughly.

Possible effects of rein tension on behaviour have recently been widely researched in equine disciplines due in part to the emergence of interest in the Rollkür training method. The relevance of the research into Rollkür for the bitless bridle is important, as rein tension applied through the practice of Rollkür may be an issue just as much as the actual use of a bit in the horse's mouth. Rein tension is also a potential contributory factor in the behaviour of the horse whether it is wearing a bitless or bitted bridle, and has been measured technically with the use of different types of equipment (Clayton *et al.* 2010, Heleski *et al.* 2009). A study on bridle-naïve two year old horses reported that the subjects were willing to trial stronger rein tension in order to reach a food reward the first time it was applied, and then this willingness decreased as the experiment was repeated on subsequent days (Christensen *et al.* 2011). The report tends to suggest that the horses were deciding whether to exert more pressure on the reins, and that their decision depended on the amount of pressure onto the diastema. The length of rein was also altered, giving a higher incidence of observed behaviour when the reins were at their shortest. This appears to suggest that it is not only the rein tension *per se* that the horse tries to avoid, but also reduced inability to flex their necks due to shorter reins.

Rein tension can also impact locomotion and affect the length of an individual horse's strides (Edwards & Randle 2009), where certain types of reins have been shown to extend or decrease the amount an individual animal lifts its hind legs (Biau *et al.* 2002). It also seems to affect the behaviour of the horse when the rider fails to release this pressure caused by the rein acting on the bit in the mouth (Nyman *et al.* 2010). The half-halt used in equitation consists of pressure applied consecutively on the reins and the flanks of the horse, and if these pressures are applied together abnormal

behaviour may result (McLean 2008). The training of pressure release is very commonly used with equines, and is employed through the method of negative reinforcement. Horses adapt to these pressures well and learn very quickly how they must act to remove the pressure applied; hence this method is used frequently in horse training (McLean 2003). However, the rider needs to make sure that use of negative reinforcement when applying rein pressure is of an effective amount whilst not causing any type of injury to the horse's mouth.

Research into normal or abnormal behaviour displayed when a horse is ridden in a bitted or bitless bridle to date has been subjective and only researched in the Cook paper of 2009. Subjectivity can be identified in this study due to the behaviours exhibited by the horses described in the language of a dressage judge, and in their conclusions based on anecdote and lack of evidence supporting decisions made when awarding points to each rider. Currently, although under development (Huws *et al*. 2012), an ethogram for the ridden horse has not been published where actions performed may reflect the occurrence of abnormal behaviour.

Abnormal behaviour in the equid when ridden in this context may be referred to as conflict behaviour. This description is a little confusing in itself, being used in lay publications and in the media with sometimes incorrect or misleading explanation given. Conflict behaviour seems to indicate that a stress response is being experienced by the animal involved, and therefore there arises a need for duty of care towards it facing this phenomenon. Animal psychology historically reported that conflict behaviour took place in many different situations and species therefore taking its place

in the behavioural repertoire. It has been reported in rats by Soubrie *et al.* (1972) and in golden hamsters by Georgakopoulos & Etienne (1997).

Conflict behaviour in horses has been reported on in a collection of four examples by McLean (2008), where it was stated that this can occur if two signals are given to the horse simultaneously, therefore confusing the animal and resulting in conflict behaviour because it does not know which stimulus to respond to. McLean also looked at the question of whether a horse was responding to the pressure from the bit controlled via the reins by the rider as a motivation to stop, rather than the fact that the horse was reacting to the previously trained learned behaviour of pressure of the bit to stop. If this is the case, when pressure is applied to the reins and then not released when the horse has responded this may confuse the horse into not understanding what the pressure actually means.

It is also possible that displacement activity may be playing a part in the conflict behaviour shown by a confused equine. Displacement activity is explained as a series of behavioural sequences that are displayed in an uncommon setting (Houpt & McDonnell 1993) and are thought to happen when the animal is not able to respond to its motivational needs. A horse asked to stop by its rider when it is wanting to react to the flight response may display behaviours such as bucking and/or rearing showing its level of confusion or frustration at being asked to perform the trained behaviour.

With horses conflict behaviour does seem to emerge from this confusion, but in some cases from two trained responses to particular cues occurring simultaneously, hence offering no choice in which cue to actually respond to. Behavioural reactions known as

conflict behaviour are therefore very common in all types of horses (Hockenhull & Creighton 2008) and are displayed by different behaviours exhibited by the horse including tail swishing and head tossing (Heleski *et al.* 2009).

Conflict behaviour in horses is often mistaken for misbehaviour in popular magazines and websites, and has also been reported as a factor affecting performance (Buckley *et al.* 2009). The conflict behaviour displayed must be separated from any notion of 'bad' or problem behaviours in the horse, otherwise it can lead to the horse itself being the culprit rather than the effect of inexperience of the rider or the severity of the equipment used (Williams & Warren-Smith 2009). There is temptation in the equine world to use anthropomorphic, descriptive language when addressing equid behaviour, which as McLean (2009) stated is not helpful to scientific research. Horses display variation in conflict behaviour with minor actions such as head tossing and tail swishing to major displays including bucking and rearing (McGreevy 2003). Interestingly conflict behaviour has been described as occurring during dressage competitions at all levels from novice to professionals (Williams & Warren-Smith 2009) and its occurrence has also been noted in leisure horses (Goodwin *et al.* 2008). It has become increasingly important to try and resolve issues of conflict behaviour in ridden horses due to the emerging awareness by leisure riders of equine welfare as well as the aspect of human safety when riding a horse known to perform dangerous behaviours such as rearing and/or bucking.

The history of animal welfare can be traced back to the first law passed in 1822 named Martin's Act (Liaison Group of UK Animal Welfare Advisory Bodies, 2013). This act maintained that animals were more than mere property not to be stolen, and that

they now had protection against cruelty in their treatment by humans passed as criminal law. Throughout the 19th and 20th century animal welfare law expanded to protect many different companion, wildlife and laboratory species. An important development in 1985 was the Brambell Committee Publication (Department of Environment, Food and Rural Affairs 2011). The Brambell investigation examined the welfare of livestock living in intensive farming conditions, and from it developed the Farm Animal Welfare Advisory Committee and the basis for the concept of the 'five freedoms' (www.rspca.org.uk 2013). Current law includes the Animals (Scientific Procedures) Act 1986 (ASPA) and the Animal Welfare Act (www.legislation.gov.uk 2006). The Animal Welfare Act changed the bias of the original idea that people could only be prosecuted once suffering had taken place, to the current situation of responding to a duty of care where if suffering might happen the law comes into effect to prevent it (www.rspca.org.uk 2013). In the 21st century ASPA was updated by Directive 2010/63/EU (2013) to include cephalopods in consideration of new research on their behaviour and cognition. This progress of animal welfare law can be seen to be affected directly by discoveries in species behaviour and cognition, and new research may indeed provide the same considerations in the future.

Attention given to the emotional and biological state of horses has changed focus from a livestock animal to one now used for equitation purposes. The field of equitation science considers new welfare concerns of the ridden horse, and is represented by the International Society for Equitation Science (www.equitationscience.com 2013). Horses are therefore represented in animal welfare law, which has been defined in many different publications. One such definition of animal welfare is stated in Saunders Comprehensive Veterinary Dictionary (2012) as:

"*…the avoidance of abuse and exploitation of animals by humans by maintaining appropriate standards of accommodation, feeding and general care, the prevention and treatment of disease, and the assurance of freedom from harassment, and unnecessary discomfort and pain*."

The last section of this statement describes a freedom from distress and pain and this must include concern for the methods used by humans in riding and training horses, and also the equipment involved. A review article on animal welfare (Carenzi & Verga 2007) reported the need for the approach to animal welfare to cover a broad spectrum of different thinking from varied scientific backgrounds. Heleski, a world-renowned animal welfare scientist, commented further in a report that emotional states of horses must be considered alongside physiological effects (Heleski & Anthony 2012).

Anecdotally, bitless bridles tend to have favourable reports on websites and publications, though further rigorous scientific experiment must take place before the bitless bridle is considered as an advance in the field of equine welfare. Indeed, novice leisure riders trialling the bitless bridle may well represent a welfare concern, combined with the unknown effect of the bitless bridle on an inexperienced horse habituated to the presence of a bit in its mouth.

Concerning welfare and its application to emotional states, a recent report stated that a human psychological condition known as 'learned helplessness', where an individual withdraws and becomes helpless due to frequent and inescapable abuse (Randle 2008) might occur in horses housed and trained in particular environments. Learned

helplessness has also been reported as a possible result of conflict behaviour in research studying the effect of different training regimes (McLean 2008) and in a review of literature concerning the subject (Hall *et al.* 2008). A horse displaying learned helplessness will exhibit disinterest in its surroundings, possibly leading to welfare issues around feeding, training and indeed general health. The phenomenon has also been seen in other animal species and specifically rats where research has reported that a certain breeding programme can produce rats that display learned helplessness without being exposed to the conditions that predispose individuals to it (Schulz *et al*. 2012).

In order to be able to scientifically determine exactly which behaviours may be indicative of impaired welfare in the horse, and also impact the safety of the rider, a ridden horse ethogram must be utilised in any research. The use of ethograms in behaviour observation has been extensively used in many different species such as in play activity in Old World monkeys (Petru *et al.* 2009), and social behaviour in fruit flies (Dankert *et al.* 2009). Behaviour can be quantified easily and therefore observed accurately by the construction of an ethogram, such as the ones used for the above research. In horses the use of the ethogram has been applied to study the behavioural disparities between feral and domesticated horses, in order to attempt to solve many modern horse husbandry issues. Kiley-Worthington found in 1987 that groups of feral horses spend much more time grazing than their stabled counterparts, leading to displacement and redirected behaviours being performed by those horses confined to inside environments on restricted feed. The prevalence of these behaviours can affect the performance and health of the horses that suffer them (Henderson 2007).

The use of an ethogram to catalogue behaviours in horses ridden in bitted and bitless bridles has not been published to date, but when created it will enable and permit an accurate and scientific investigation into the various actions performed by the chosen cohort. Previous research into the comparison of bitted and bitless bridles has tended to look at the basic behaviours of the horse (Cook & Mills 2009; Quick & Warren-Smith 2009) rather than the aspects of conflict behaviour that can possibly lead to damaging welfare issues. The lack of research in this area is of concern to horse owners and trainers interested in adopting the method of riding with a bitless bridle, and therefore further research into the efficacy and behavioural responses of horses ridden in bitless bridles in comparison with the bitted standard is required.

The study was conducted in two parts and is presented in two chapters in the methodology. Chapter 1 uses a qualitative questionnaire aiming to identify the characteristics of the leisure rider, their opinions, habits and experiences when riding and when providing for their horses. This was important to the quantitative experiment in Study 2 as there was a need to define the profile of a leisure rider to confirm the characteristics of the rider used. Its objective was to discover whether leisure riders did tend to conform to the statement issued by Muller (2010), therefore the hypothesis tested that leisure riders would indeed conform to his statement.

Chapter 2 uses experimentation to investigate the comparison between horses ridden in bitted and bitless bridles. The experiment was designed to test the initial effect of the Dr Cook bitless bridle and not the long term effect it may or may not have on welfare in the future. Therefore comparison took place between the subject's usual bit and bridle and the Dr Cook bitless bridle observing the behavioural response of the

horse in both types of bridle. Horses were ridden in this type of bitless bridle for the first time, so comparison is centred on the novel experience. This chapter uses this quantitative experiment to ascertain if there are significant behavioural differences between horses ridden in bitted bridles and bitless bridles. The alternative hypothesis tested that there will be a significant difference between the behaviours exhibited by horses wearing both types of bridle.

Chapter 1

Materials and Methods

The qualitative study involved the production of a questionnaire in order to define the term 'leisure horse' and 'leisure rider'. As the horses used in the research were intended to be what has been described as those ridden by 'leisure riders', the questionnaire was used specifically to determine what characterises a 'leisure rider' and produce a working profile to describe their characteristics. There does not appear to be a generic description of a leisure rider in literature; however Basche (1984) reported in Germany that research stated 70% of 1.6 million riders could be described as participating in leisure riding as opposed to equestrian sport. At a Fédération Equestre Internationale conference in 2010 a description was given in an address by Dr Harald Muller, the Executive Director of Development and Sports. He stated

"Leisure riders practise simple riding (i.e. horseback riding) and/or low-level performance sport. Their motivation is basically relaxation, enjoyment, experience of nature and the animal".

Subjects

It has been suggested anecdotally that novice and/or new riders are most likely to try out new pieces of equipment than established and possibly more knowledgeable riders (Randle, 2006). It is therefore sensible to use this population (n=68) as subjects for the qualitative element of this investigation. To reach the potential subject base a website page was created by the author containing the questions with a link provided to publish to social networking websites. The link was also sent by electronic mail to

college contacts to forward and reduce bias. 68 respondents answered the questionnaire in total. The number of subjects that responded was seen to be disappointing, and in a further study using the same potential subject base a population of n=426 was achieved.

Materials

A questionnaire was created to attempt to identify and profile the character of the leisure rider and where they fit into the diverse world of horse riders and owners. New and/or novice riders are not all leisure riders, and vice versa, although with the use of a questionnaire further data could be collated to describe the facets of this type of rider. The questionnaire was designed using the freely available website www.kwiksurveys.com, to provide a simple means of data collection. It was then published to different equine-related online Internet forums for example Horse and Hound and Horse and Rider, given out as a paper document with the link displayed to local riding schools, Bridgwater College equine students, emailed to other colleges and also advertised as a separate link on its own Facebook social network Internet page. Demographics were not collected with this questionnaire and the survey was approved by the University ethics committee.

Questions were designed to ask about various aspects of the leisure rider's connections with horses, and focussed into sections about their specific riding and also what equipment, including the bitless bridle, they had experimented with. Closed questions were asked initially regarding the type of riding that the person answering the questionnaire took part in (see Table 1).

Table 1 – Questions asked

How many (if any) riding lessons do you have each week on average? (Riding lesson taught by a recognised qualified instructor)
How many times do you go hacking each week on average?
How many times do you school each week on average? (Defined as riding your horse in an arena or area designed to work on improvement)
Where do you mostly hack out? on the road/on bridle paths/on permissive routes (tracks and paths)/on land owned by your livery yard/on land owned by yourself
How long do you hack out for on average? up to an hour/between an hour and two hours/between two hours and three hours/over three hours
Do you take part in local shows? (Local shows defined as events organised in your area within around one hour's travel)
Do you take part in any type of affiliated show or event?
Have you ever bought or borrowed a new or different piece of tack to try out on your horse?
If so, where did you buy/borrow it from? tack shop//internet site/friend/riding instructor/other professional
Have you ever tried riding in a bitless bridle? If so, why?
How often do you buy a new piece of tack to try out on your horse?

Often/sometimes/rarely/never
Please list the three most recent items of tack you have bought or borrowed:
How do you rate your level of knowledge regarding: Husbandry/Tack and equipment/Feeding/Health/Worming/Shoeing
Where do you get your knowledge from? Magazines/books/websites/professionals/vets/friends
What is your highest level of qualification in equine subjects? none /NVQ/National Diploma/Foundation Degree/Bachelors Degree/Masters Degree/PhD

Procedure

In the first question participants were asked to provide information on their riding lesson attendance. The criteria included the statement that the lessons had to be taught by a qualified instructor. The second question asked if the participant schooled their own horse in an arena or area set out as an arena (schooling a horse on a flat surface with no jumping involved). The first two questions were included to gain an insight into how much training the leisure rider took part in.

The second section was created to explore the leisure rider's hacking profile. Hacking can be explained as riding a horse for pleasure only, with no competition or training involved, and with a variety of components such as all the gaits including gallop in some cases, and also inclusion of natural jumps (fallen trees) in woods and forests. Research has reported that hacking is the most common activity for groups of horse owners to partake in, with riding club and pony club activities taking second place

(Mellor *et al.* 2001). Questions asked the length of time that each participant spent hacking on a single ride, how many times a week and where they would usually hack their horses. Most riders may have contact with dangerous environments such as roads where traffic is encountered. It has been reported that riders do encounter accidents and dangerous situations and therefore represent a significant vulnerable presence on the road system (Chapman & Musselwhite 2011).

The next section explored the participant's involvement in local shows and affiliated competitions. Studies have stated that 21% of riders do take some part in showing (Mellor *et al.* 2001) though do not report on how often these riders might attend affiliated events. Affiliation can be described as competition held under specific rules for the section of equestrian sport that it is concerned with (www.goaffiliated.co.uk). There are certain standards of health and safety that have to be adhered to, including the addition of qualified judges as well as competitors having access to registered competition days unavailable to the unaffiliated rider.

The subsequent section of questions examined the use and interest in horse tack of the various participants. Horse tack can be explained as any part of the equipment used on a horse when riding it, such as saddle, bridle, breastplate or girth. The first question explored the actual purchase or lending of any different piece of tack used by the participant. It asked if they had actually purchased or loaned a piece of equipment to gain data relating to the number of leisure riders who experimented with novel tack items. The next question asked the origin of the item, where it was purchased or loaned from. This section included purchasing from tack shops and the internet, or loaning from friends/colleagues, riding instructors or other professionals.

The next question regarded bitless bridles and asked participants if they had ever experienced riding a horse wearing a type of bitless bridle. Participants were then asked to explain in open sentence structure why they had ridden in this type of bridle. Other questions asked specifically how often a new piece of tack was bought to use on a horse and then an open question asking for information on the actual pieces of tack bought by the participant.

A section of closed questions were included in order to gain a representation of the level of knowledge of participants. A summary of equine subjects were listed, those being husbandry, tack and equipment, feeding, health, worming and shoeing. Levels of above average, average and below average could be indicated for each subject. The questions asked where this knowledge was actually learnt or obtained, from a choice of magazines, books, websites, professionals, veterinary surgeons and friends. This was included to complement research in areas of rider and owner knowledge. A study concerning worming reported that less than 50% of correspondents involved a veterinary surgeon when investigating which type of anthelmintic would be best suited to their horse (Allison *et al.* 2011).The final question was included to gain a perspective of qualification level in leisure horse owners. The question asked what was the highest level of education gained by the participant, and stated levels starting from Doctor of Philosophy to Masters Degree, Bachelors Degree, Foundation Degree, National Diploma, National Vocational Qualification to none held. Research was carried out in New Zealand to ascertain if facial injury at local riding stables was in part caused by lack of knowledge of handling (Meredith & Antoun 2011). It was reported that 67% of injuries were possibly sustained due to this lack of knowledge.

Data Extraction

The questionnaire data were collated onto Microsoft Excel using the website tool to give a readable list of all the data collected. Each question was then tabulated onto a separate MSExcel sheet to display percentages of each answer. An MSExcel sheet was then created to display the numbers of participants for each question in order to process the raw data. The number of participants was then analysed using Chi-squared by MiniTab v16. Charts of expected and observed amounts were created to further show the data in each result. Chi-squared analysis was conducted in order to test hypotheses of each expected and observed amount and the qualitative data generated by open questions with open input were then categorised into table form in order to analyse the answers given.

The closed questions that were answered with a yes or no are displayed together to show comparison across the content of these answers. The level of knowledge questions were pooled together to produce a simplified display of analysis for the discussion. The question concerning qualification levels was kept separate showing the percentage of each qualification across the 68 participants.

Results

The qualitative questionnaire provided a series of closed question results represented in chi-squared analysis and also as percentages.

Chi-Squared Results of Selected Questions

Chi-squared analysis took place to examine goodness of fit between pairs of questions.

Table 2 – Closed question results

Closed Question	Ch-sq_1 value	Percentage
attended riding lessons weekly	7.12; P<0.05	66.67%
schooled horses weekly	19.06; P<0.05	23.53%
rode on road system	P<0.05	82.35%
attended local shows	5.26; P<0.05	58.82%
attended affiliated shows	39.80; P<0.05	11.76%
bought/borrowed new piece of equipment	64.10; P<0.05	98.53%
ridden in a bitless bridle	3.80; P<0.05	38.24%

The results from the questions regarding the knowledge of the participant as rated by themselves on a scale of above average, average and below average:

Table 3 – Level of knowledge question results

How do you rate your level of knowledge regarding:	Above average	Average	Below average	Ch-sq$_1$ value
husbandry	26.47%	67.65%	5.88%	40.35; P<0.05
tack/equipment	17.65%	72.06%	10.29%	46.44; P<0.05
feeding	17.65%	75.00%	7.35%	54.21; P<0.05
health	19.40%	67.16%	13.43%	34.87; P<0.05
worming	17.91%	58.12%	23.88%	19.01; P<0.05
shoeing	17.91%	55.22%	26.87%	15.25; P<0.05

Participants were also asked if they possessed a qualification in equine subjects:

Table 4 – Qualifications in equine subjects

Possess a qualification	Do not possess a qualification	Ch-sq$_1$ value
27.94%	72.06%	13.20; P<0.05

Open question results

The two open questions, numbers 11 and 13 respectively, are represented separately as two tables showing the answers obtained. The first is Question 11, where participants were asked to explain why they either had or had not used a bitless bridle. Out of 68 responses to the questionnaire 36 participants made comments as below (Table 5).

Table 5– Responses to Question 36 – why participants had/had not used a bitless bridle

To try it out.
I have never considered a bitless bridle because of the cost and no need.
Horse not settled with a bit!
I regularly rode a horse that was already in a bitless bridle, thought it was great.
Because that is what pony was ridden in.
I thought my horse had a sore mouth at the time. Used it for a few months and returned to a bitted bridle.
Happy with the way horse is going.
Don't know enough about them and would be unsure that I would feel confident in having brakes!! Not competent enough.
My horse goes well in a simple snaffle so never felt the need.
I trained my horses using a dually and progressed into riding them with it as well. I do not feel a bit should be used to control. I personally feel it is ethically wrong to place a metal device into an animal's mouth.
I haven't and wouldn't as I don't like them personally.
Horses I have purchased were ridden in bits, so never considered changing.
Strong horse, tried lots of different bits.

Have trained my horses using natural horsemanship techniques and both can be safely ridden in rope headcollar with reins.

One of my rides is ridden in a bitless bridle by choice of the owner.

To see if it made a difference on the amount of control I had and also because the other horse wouldn't have a bit.

On a horse which gets his tongue over the bit.

Horse didn't listen to the bit very well and had a sore mouth.

To give my horse's mouth a break.

Not had one available.

She goes well in a snaffle so no need to mess about with it.

First time because horse had overgrown teeth and even after treatment didn't accept the bit and worked happier bitless I then tried it again on my second horse out of interest.

To improve the horse's way of going and to find out if it is kinder.

Was riding a friend's horse that has a sensitive mouth and works better without a bit.

On a friends horse who had a sensitive mouth.

I hacked in a hackamore as the mare has a sensitive mouth and only uses a bit when eventing.

The horse was headshaking and wanted to see if he went better in it.

To see if there was any difference.

I would like to try one.

To try it out.

The horse I was riding was never put in a bit.

Because it was someone else's horse and they rode in it so it was only used to a bitless.

Never had the opportunity.

To try it out on a young horse.

Tried one on a friend's horse.

My horse is ridden in a scawbrig.

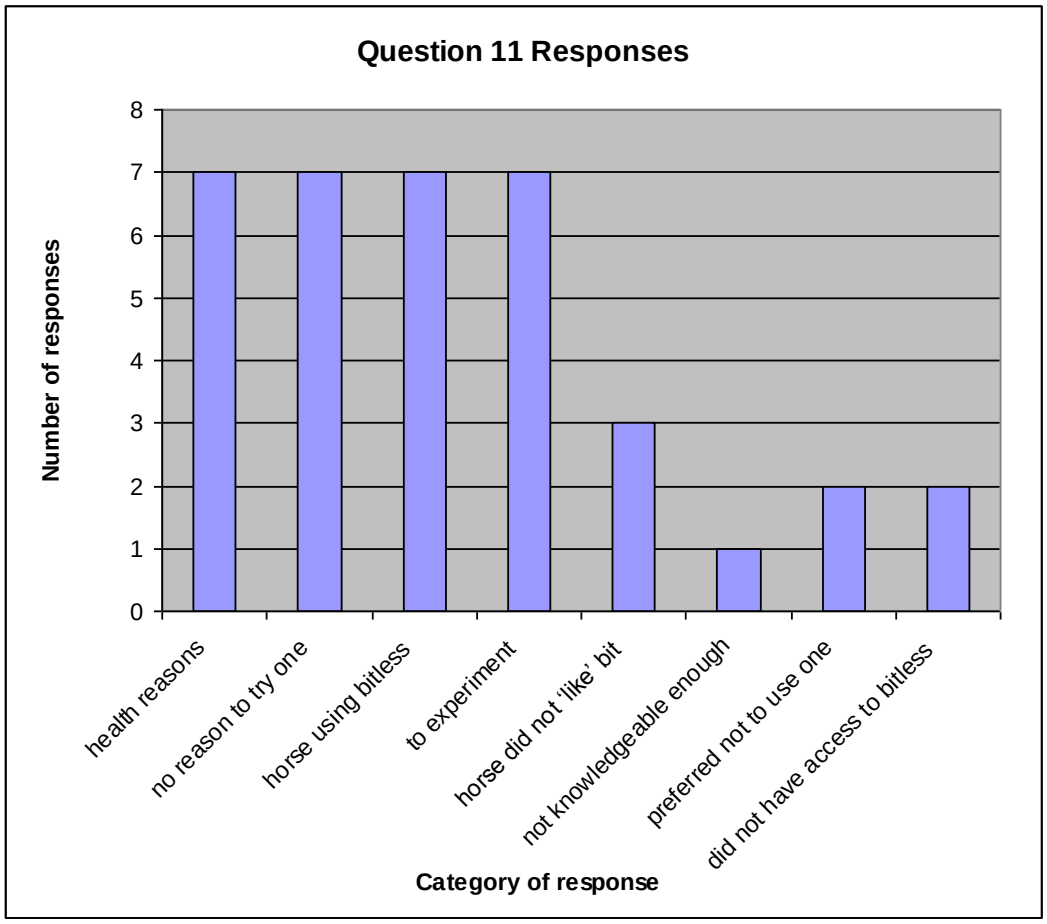
The 36 responses to Question 11 were categorised into eight sections with five main reasons followed by three that reflected participant subject knowledge (table 6):

Table 6 – Categorised responses to Question 11

Five main reasons why a bitless bridle had been trialled:	**Three reasons why a bitless bridle had not been trialled:**
Health reasons (sore mouth, dental problems)	Not knowledgeable enough
Horse already ridden in one	Preferred not to use
To experiment	Did not have access
Horse did not like it (stopped using it)	

The results are shown in bar chart form (figure 4) to clarify the sections as shown above.

Figure 4 – Bar chart showing reasons why bitless bridle trialled or not trialled



The second open question, number 13, asked for the three most recent types of tack purchased by the participant. 48 of the 68 respondents provided an answer (table 7).

Table 7 – Question 13 - Most recent types of tack purchased

Most Recent Types of Tack Purchased
bit, bridle, brow band
‘myler’ bit and a non-leather bridle
‘Rambo’ bridle, flash noseband, ‘Neue Schule’ snaffle
saddle, bit, reins
saddle, bridle, endurance stirrups
two saddles and a bridle
natural horsemanship headcollar, lunge and schooling line
rug, saddle, numnah
‘Rugby’ Pelham, new saddle and brushing boots.
double bridle, inside grip reins, martingale
girth, bridle, saddle cloth
flash noseband, Pelham bit, tendon boots
grackle bridle, gel pad, over reach boots
bridle, saddle, boots
bits, boots, rugs
bits, saddle
‘Willkie bit’, draw reins
breastplate, saddle, girth
bridle, reins, bit

hanging cheek snaffle, winter saddle
noseband, stirrup leathers
grackle
‘Bates’ dressage saddle, side reins, ‘Micklem’ bridle
saddle, stirrup leathers, reins
bridle, stirrups, girth
breastplate, kimblewick bit
market harborough, drop link snaffle
cavesson, side reins, lunge rope
bridle, race exercise saddle, race saddle
hunter breastplate, tom thumb snaffle
loose ring snaffle, breast girth, close contact jumping saddle
saddle, reins, stirrup leathers
hunter breastplate, martingale
bridle, girth, bit
3 ring Dutch gag, side reins, crank noseband
webbing bridle, Pelham bit, knee boots
saddlecloth, headcollar, whip
five point breastplate, saddle, stirrups
sheepskin saddlecloth, breastplate, martingale
sheepskin girth, bridle, martingale
girth cover, bridle, snaffle bit
saddle cloth, bridle, breastplate
saddle, stirrups, stirrup leathers

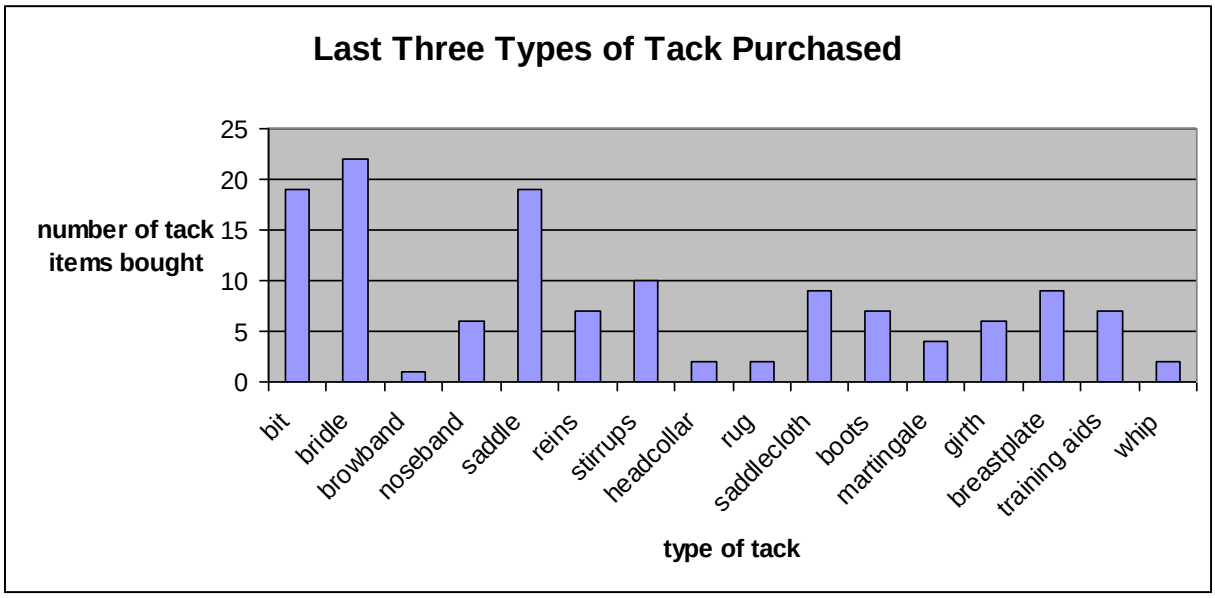
numnahs, bridle
whip, stirrup irons, reins
boots, saddle, bridle
saddlecloth, breastplate, tom thumb bit
saddlecloth, saddle, stirrups

The types of tack were categorised for ease of interpretation as below:

- Parts of the bridle
    - Bits
    - Bridles
    - Brow bands
    - Nosebands
- Saddles
- Reins
- Stirrups/stirrup leathers
- Head collars
- Rugs
- Saddlecloths/numnahs
- Boots
- Martingales
- Girths
- Breastplates
- Training aids
- Whips

The results are displayed in a bar chart for clarity (figure 5).

Figure 5 – Last three types of tack purchased



Profile of the Leisure Rider

When profiled the leisure rider appears to be an individual who attends riding lessons weekly but does not tend to school their own horse/s. This type of rider uses the public road system significantly more when exercising their horse/s than bridle paths, permissive routes or other available land. Leisure riders mostly attend local shows, and do not tend to go to affiliated competitions. A significant number of leisure riders do buy or borrow tack and equipment items to trial on their horses, although it was not a characteristic to trial a bitless bridle. The three most bought and/or borrowed items were bridles, bits and saddles.

The knowledge section demonstrated that the leisure rider rates their own level of expertise across husbandry, tack and equipment, feeding, health, worming and shoeing as average in all areas. The highest score of above average appears in

husbandry, which also has the lowest score of below average. The leisure rider is generally not qualified in equine related subjects at any level.

Chapter 2

Materials and Methods

Subjects

The subjects were first selected for their lack of experience of wearing a bitless bridle of any type so to observe their first responses to this type of bridle compared to their own bitted bridle. Comparison was therefore made between the behaviour of the subject in their usual bitted bridle and also behaviour when wearing a bitless bridle by way of a novel experience.

Twelve subjects were used as the sample size based on examination of the current literature and published studies researching bitted bridles and/or rein tension. Quantitative research was identified with the sample sizes of horses noted according to the power analysis, and consisted of examples of 8, 15, 8, 4, 12, 8 and 7 (Biau *et al.* 2002, Christensen *et al*. 2011, Clayton *et al.* 2010, Heleski *et al.* 2009, Manfredi *et al.* 2005, Sloet van Oldruitenborgh-Oosterbaan *et al.* 2009 & Van Dierendonck *et al.* 2010) respectively. These indicated that between 4 and 12 subjects are the typically used sample size. The only study using a greater sample size was qualitative and longitudinal. The study used a sample size of 29 horses, with data produced from anecdotal experiences of horse owners and riders in a longitudinal field study lasting for a period of five years.

Power Analysis was also utilised to estimate the probability that the experiment would be able to reject a null hypothesis based on the sample size of 12 horses. Therefore a sample size of 12 subjects was used. Ten of the subjects were recruited from a

population of horses kept at Bridgwater College in the south west of England and the remaining 2 privately owned by a leisure rider. The two horses not kept by Bridgwater College had both spent time in a riding school environment similar to that of the college horses. All horses were used to being ridden by many different riders. At Bridgwater College horses were ridden by outside clients as well as students and the two privately owned horses were also used for livery customers.

The subjects were recruited according to their basic level of ability (trained in fundamental riding school movements and therefore capable of performing a British Dressage Preliminary test), their maturity (over the age of 5 years), their height (all horses therefore over 147.32cm high), their level of show and event experience (local level only- described in the questionnaire as within an hour's journey) and temperament (able to be ridden and controlled by novice riders).

The information required for each horse was name, age, type/breed, height, location, colour and sex. The type or breed of each horse identified either its purebred status, such as a Thoroughbred as appearing on its passport, or a type such as cob, usually given as an explanation of its possibly unknown background breeding by the owner. Anecdotally, many horses exist in the leisure rider community of unidentified breeding as this is maybe not as important as having a temperament to suit the leisure horse's use. The demographic data for each subject can be found in Table 8.

Table 8 – Demographic data for each subject

Subject	Height (in cm)	Breed	Age	Sex
1	154.94	Welsh Section D	16	gelding
2	160.02	Irish Sports Horse	15	gelding
3	154.94	Connemara X	12	gelding
4	149.86	Gypsy Cob	10	gelding
5	167.64	Ardennes X	14	mare
6	180.34	Thoroughbred	14	gelding
7	162.56	Thoroughbred	6	gelding
8	154.94	Welsh Cob	22	gelding
9	167.64	Irish Sports Horse	10	gelding
10	162.56	Cob X	16	gelding
11	160.02	Irish Sports Horse	15	gelding
12	162.56	Thoroughbred	18	gelding

Legend: x = crossed with

Equipment

The video camcorders used were a Sony Handycam DCR-HC51, a Sony Handycam DCR-TRV17E, a Sony Handycam DCR-HC22E and a SanyoXacti VPC-TH1. Every model used mini DV or SD video tapes that were able to be transferred to a computer playable DVD format. The four different models were used because of problems with battery life and power point availability at the far ends of both arenas, meaning that the models at the far end were swapped as they were charged. Each video camcorder was mounted on a tripod to ensure stability of image capture during the ridden tests. The tripods were set up at opposite diagonals of the arena in order to afford an uninterrupted field of vision of the horse and rider performing the test (see Figure 18). A total of four people were used to operate the cameras, with two on each camera and the author officiating the start and end times in order to maintain continuity with each test.

Test Environment

The quantitative experiments were conducted using a systematic method where each criterion was followed to ensure consistency across the different locales. These were riding arena size, type of surface, weather, season and time of day. All arenas were outside with surfaces containing a rubber mix, enclosed with wooden post and rail, fences and bushes. Taking into account Pinchbeck *et al*. (2004) observation that wet and windy weather may have a significant effect on equine performance, the tests only took place on calm (wind observed less than 3 on the Beaufort Scale (www.metoffice.gov.uk) and dry (no precipitation) conditions. The data collection took place between 16th June 2011 and 14th October 2011 so no frost was

encountered that may have led to changes in surface conditions. All data were collected in the mornings only and between the hours of 9am and 11.30am.

Arena size

The British Dressage Preliminary 4 test is designed to be ridden in an arena size of 20 metres by 40 metres, which has been reported as being the most common size of arena used by British Dressage members (Murray *et al*. 2010). The normal size of arena as used by the majority of test subjects is 65 metres by 45 metres, and the arena used by the other two subjects is 60 metres by 40 metres. The surfaces of both of these arenas comprise similar mix of rubber and sand (in ratio of 1:1) and depth of surface was again similar (5.1cm to 10.2cm). Both arenas were also fenced with post and rail, and sided with trees, stables and open areas. They were also chosen for the similarities between location (away from traffic, houses and passers-by) and for access via a 3.66m five-bar style farm gate, which in both cases swung inwards into the arena.

Procedure

The pilot study required selection of a British Dressage Test to be used in the experiment in order for the subjects to perform the same set of movements and gaits. Dressage as a discipline can be defined as a period of time where a schooled horse demonstrates how the rider and/or trainer has developed its education to perform a detailed structure of movements, changes of gait, direction, stride length and speed to a published order (www.britishdressage.co.uk).

In the pilot study three dressage tests from British Dressage were selected on the basis of criteria important for the rider and also for experimental design.

The following criteria were utilized:

The test is:

- Of an undemanding structure
- Easily remembered by the rider
- With a spectrum of gaits
- With a spectrum of directional movements
- At a sufficient level for the subjects to perform

The test was selected to be at a sufficient level for a leisure horse to be able to complete satisfactorily according to fitness, schooling level and ability.

The three British Dressage tests that conformed to these criteria were Preliminary 4 (2002), 12 (2005) and 14 (2006) (www.britishdressage.co.uk). Each test was observed with the rider using a horse which did not participate in the pilot study, and examined for the criteria as listed above. Following discussion and consultation with the rider Preliminary 4 (2002) was identified as the most appropriate because it offered the most simplicity with progression in the gaits and a change of stride from slow to faster paces. Preliminary Test 4 is also one of the simplest routines to learn for the designated rider who needed to ride each test correctly every single time. This test includes the elements of 20 metre circles in trot and canter and half 10 metre circles in walk with changes of direction (known as changes of rein) across the diagonal of the arena (www.limebrook.com, www. britishdressage.co.uk).

In the pilot study two horses were ridden by the same rider in a 60 metre by 35 metre outdoor arena similar to those being used in the main study. In the pre-test routine

horses in the order they were to be used were secured in their own home stable or area with their usual headcollar and lead rope and given a full groom completed by either college students known to them or their owners and riders. Each subject was then tacked up in their usual saddle, girth and saddlecloth ten minutes before they were needed in the experiment. Horses were then led out to the arena in their headcollar and lead rope by a student helper or their owner/rider where the bitless bridle was placed on by the author in order for any adjustments to be made regarding fit due to the subject's different head sizes. Each subject was then led around the arena in the bitless bridle by the experimental rider for her to gain familiarity with each horse for approximately five minutes. The rider then mounted the horse using either a moveable mounting block in the case of the privately owned horses or a stationary mounting block situated at the side of the arena used by the college horses.

In the pilot study various methods were trialled to attempt to disguise or camouflage the bridles from the rider and observers. However during these attempts it was quickly realised by the rider on mounting that she could instantly tell through the feel and position of the reins which bridle was being used. Therefore bridle camouflage was not used in the proceeding full experiment.

Development of Ethogram

The data collected in the pilot study were used to develop and construct a ridden horse behaviour ethogram to be used specifically for this study. Behaviours observed were noted then photographs taken for its creation over a three day period. The forming of the ethogram involved the completion of an observation record cataloguing the behaviours observed. Photographs were taken using a Sony PowerShot A470

digital camera whenever behaviour occurred. The behaviours logged in these sessions were tail swishing, opening mouth, cow kicking, bucking, hollowing, overbending, falling out and pulling down. A descriptive ethogram was created to clearly explain these behaviours (see Table 3) and a line drawn representation sheet (see Figure 2) was devised in order to identify the behaviours correctly (Jenson 1980).

Previously published ethograms were considered, comparing the behaviours collected with those identified by these other studies. In research with therapeutic riding horses the ethogram included behaviours focussed mostly on the individual horse's head actions, and described in the study as related to the stressful situations the animals experienced due to being ridden by a variety of children with and without various disabilities (Kaiser *et al.* 2006). An ethogram of defined behaviours was created for another study where the action of martingales and reins with elastic inserts were observed in ridden horses (Heleski *et al.* 2009). Both of these studies contained tail swishing and hollowing as indicators of stress behaviours so this confirmed their inclusion into the created ridden ethogram as they were also experienced in the pilot study. The equid ethogram devised by McDonnell (2003) contained information regarding the behaviour of horses when loose, and was mostly collected and observed in a semi-feral herd of Shetland ponies. It is a comprehensive collection of very detailed equine behaviour, though without any behaviours listed in regard to ridden horse behaviour.

The behaviours identified in the pilot study were those reported to be indicative of conflict behaviour in published literature, where an equid shows a response to an uncomfortable or confusing experience such as application of two different stimuli at

the same time (McLean 2008). An example of this is a movement executed by riders named the 'half-halt', where pressure is applied to the horse's flanks with the rider's legs, and at around half a second later more pressure is applied via the rider's hands on the reins. Behaviour indicative of conflict can occur when a rider attempts a half-halt and the two signals are given sequentially, instead of simultaneously. The horse is provided with two signals to respond to, 'go' from the rider's legs, and 'stop' from the rider's hands, and consequently experiences confusion. Conflict behaviour has been described in studies concerned with training young horses and is explained as a situation where multiple signalling has taken place to create unwanted actions performed by the horse (Murphy 2008).

Behaviours observed were decided upon as a measure of conflict behaviour occurring when the horse was ridden. In present literature there is no published ridden ethogram for the horse to record these types of behaviour, hence the need for a full ethogram to be created. The ethogram created differs from the therapeutic riding horse study (Kaiser *et al.* 2006) as it takes into account behaviours that may be observed when a horse is being ridden in a rider controlled manner rather than led by a helper. This includes the behaviour of falling out, where the horse falls out of its gait in a trained movement. The study concerning martingale and elastic rein inserts (Heleski *et al.* 2009) did not use a rider, so actions like bucking and cow kicking were not included. Currently, development of a ridden ethogram for observing stress responses in equestrian sports is being developed at Nottingham Trent University (Hall 2012). However, in British Dressage rules (2012) some of these behaviours may be noted and scored by the judge in the tests performed that might lead to a horse and

rider combination losing marks within their performed test. The British Dressage Rulebook (2012) states that the action of a swishing tail could be a sign of:

"…nervousness, tenseness or resistance…"

in the horse (www.britishdressage.co.uk). This means that an observation of a tail swish would therefore result in marks being deducted from the final test result.

Behaviours were chosen to reflect the negative aspects of the actions rather than positive actions so to define if conflict behaviour was indeed taking place in the experiment, and to ascertain if behavioural frequency changed depending on which bridle was being worn. Welfare considerations and recommendations might therefore be made if any result was significant between the comparisons of the two types of bridle.

The choice of the behaviours to collect data on were finalised as tail swish (TS), open mouth (OM), cow kick (CK), buck (B), hollow (H), over bent (OB), fall out (FO) and pull down (PD). These are described in the ethogram (Table 3).

Tail swishing has been reported as indicative of resistant behaviour in ridden horses. It was stated that behavioural signs including tail swishing were associated with the horse resisting the cues of the rider to perform trained movements (Wilkinson & Hall 2012), though the research involved not just the rider but also a secondary trainer simultaneously lungeing the horse (where the horse circles around a secondary trainer controlled by a long rope while it is being ridden). The presence of another human

whilst the horse is being observed could possibly affect its behaviour considering factors such as how the horse perceives the secondary trainer and if there was confusion in interpreting signals given by rider and secondary trainer. The horse may be responding to either or both therefore rendering the behavioural sign of tail swishing as a response to the secondary trainer standing in the arena. However as tail swishing is also mentioned as having a negative impact on point scoring in the British Dressage rulebook (British Dressage 2012) it was included as a behaviour to catalogue in the study.

A definition given of a horse 'accepting the bit' provides an illustration of how the horse should have a closed mouth and relaxed lips in locomotion when responding to cues given by the rider through the reins and bit (McGreevy & McLean 2010). Therefore the opposed behaviour of a horse opening its mouth could be seen as an evasive or resistant behaviour, although this can be difficult to observe if a horse is wearing particular types of nosebands (known as crank nosebands due to their physical action) that restrict the opening of the mouth. All horses in the experiment wore cavesson nosebands, which are placed above the nasal bone and if fitted correctly do not result in the possible clamping and closure of the mouth.

Cow kicking is explained in equine ethograms as a reaction to a threat from behind the animal, or nearer to its hindquarters than its forequarters (McGreevy 2004). If a ridden horse is therefore responding to a threat from the rear, it could be possible that the behaviour originates from the rider either giving a stronger cue from leg pressure than the horse is used to, or perhaps from an unexpected whip tap. As the rider did not carry a whip, this element is negated; however stronger pressure from a rider leg aid

cannot be eliminated in this case. The observed behaviour of cow kicking was however included in the study due to its links with mental trauma (www.aebc.au) and the possibility of its manifestation as a reaction to wearing the novel bitless bridle.

Bucking has been linked to a refusal by the horse to move in a forward motion when signalled by the rider or trainer on the ground (McGreevy 2004). The horse displays its resistance by bucking when asked to perform a trained response relating to accelerated locomotion in a forward direction. Bucking can also manifest as a response to physical pain in the dorsal area (Taylor *et al.* 2002), therefore it can be difficult to distinguish exactly why the behaviour of bucking is being performed under experimental conditions. It must be noted that all horses participating in the study were checked for back problems at recommended intervals by professional practitioners.

Hollowing is a term that is associated with a horse's reaction to flight response consequently a quickening of pace (McGreevy 2010). In the ridden horse it may be displayed as a reaction of resistance to the rider's cue for the horse to slow when undue pressure is exerted on the reins and in consequence the bit. The horse may increase its pace to enable it to trial escaping from the extra pressure, thus leading to the hollowing of its loins. It has also been reported that the combined weight of rider and saddle can contribute to a hollowing of the back (DeCocq *et al.* 2004), though it is unclear whether this would add to the degree of hollowing that the horse is already displaying.

Overbending has been reported as occurring when the rider uses extreme force on the reins affecting the position of the horse's head and decreasing the distance from the chest to the mandible (Heuschmann 2007). However it can also occur in a horse that is not being ridden with extreme force but has become habituated to moving in this lowered, restricted way. It has also been stated that horses that are over bent have a behavioural problem caused by the rider that needs correcting with retraining (McLean 2003).

Falling out has been reported as a flaw connected with the training of the horse to respond to slowing down and speeding up cues from the rider (McGreevy & McLean 2010). The occurrence of this behaviour may also happen when the rider is becoming fatigued and is having difficulty in maintaining consistency of cues, therefore possibly affecting the correct movement of the horse.

Horses that display the behaviour of pulling down are said to be using evasion to resist the action of the bit (McGreevy 2004). The rider may be at fault with the exertion of extreme pressure on the reins, or indeed the problem could be linked to incorrect training or use of tack and equipment. Falling out also causes loss of marks in dressage tests as described by British Dressage in the current Rule Book (British Dressage 2012).

A tail swish is an action where the horse lifts its tail rapidly vertically, or laterally, or a combination of both with a flicking action. One tail swish was recorded as a single tail movement from the start of the swish to the end of the swish where the tail then followed the movement of the body. The open mouth occurs when the horse opens its mouth exposing the teeth and maybe the bit itself usually accompanied by holding the

ears back against the head. A cow kick arises when the horse lifts either one of its hind legs vertically and sometimes also laterally within the stride it is taking in walk, trot or canter. The leg flexes, and the hoof is carried past the horse's body in a kicking motion. Bucking behaviour can be described as a continuation of the cow kick, where both legs are lifted instead of a single limb, although the kicking out movement can extend past the buttocks of the horse or be contained vertically within the perimeter of the horse's body. Hollowing is an action that can be seen in the neck of the horse, identified as a concavity of the *splenius* muscle positioned along the top of the neck, and displayed along the spinal processes flattening out the body horizontally and as a loss of rhythm and stride length.

Over bending is seen where a convex bulging of the dorsal aspect of the *splenius* muscle located at the top of the neck contracts the head into the chest, and the highest point of the horse's neck is at the joint of cervical vertebrae C2 and C3. In the British Dressage Rulebook the head must be held in a perpendicular line from the ground, through the muzzle to the ears, with preferably the muzzle carried just outside of this vertical line away from the chest area. In over bending, the head is inside of this perpendicular line, nearer to the chest. Falling out is a literal observation of the loss of stride and forward momentum in a particular gait to a slower gait, such as an unwanted transition from canter to trot. This can also be observed in a lesser degree as movement from the shoulder into the middle of a circle being attempted by the horse, where the change of gait may not quite occur. Pulling down can be described as the horse reaching down outside of its normal head carriage towards the ground when the rider has made no signal to perform this behaviour. The dressage test includes a section where the horse is asked to lower its head in a walk, though this is attempted

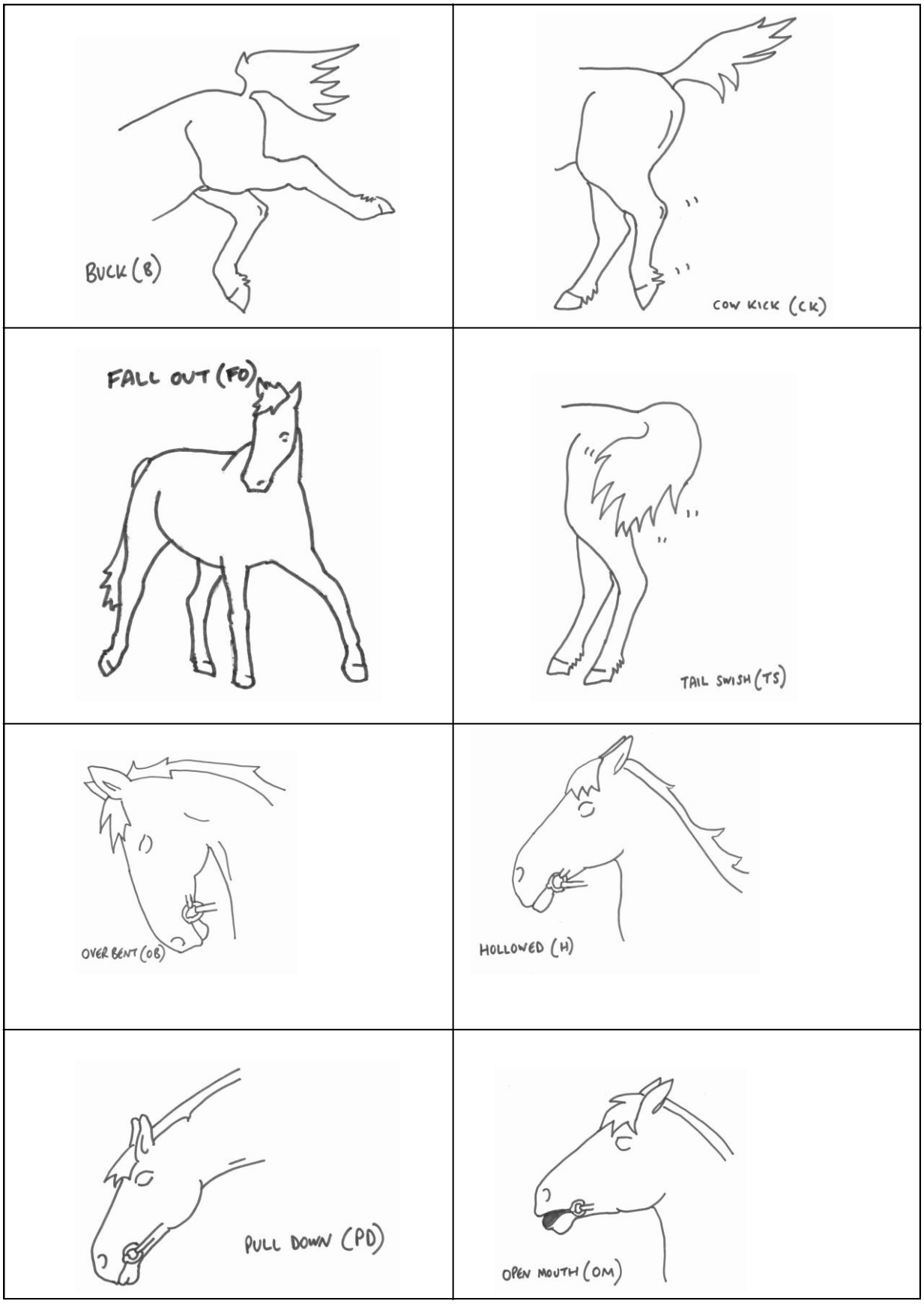
to possibly provide a judge with an opportunity to mark what is known as relaxation (www.britishdressage.co.uk).

Each behaviour was allocated a code to simplify the tallying procedure when the videos were observed. A data collection sheet was created using Microsoft Excel to record the behaviour observations simply and accurately, accompanied by information about each horse used in the research. A Ridden Horse Ethogram was then created (see Table 9) and in line drawing representations included (Figure 6).

Table 9 - Ridden Horse Ethogram

Behaviour name	Behaviour code	Definition
tail swish	TS	horse lifts tail rapidly either vertically, laterally or combination of both and action begins at the first movement and ends at the last movement
open mouth	OM	horse opens mouth to expose teeth and/or bit and holds ears flat against head
cow kick	CK	horse kicks out with one hind leg in any direction
buck	B	horse kicks out with both hind legs behind its body
hollow	H	horse brings its head up vertically causing concavity of the neck
over bent	OB	horse contracts its head into its chest
fall out	FO	horse loses forward momentum and drifts into a slower gait
pull down	PD	horse rapidly pushes its head towards the ground

Figure 6 – Drawing representation of Ridden Horse Ethogram



Test Phase

The author then signalled to the rider to advance to the start position for the British Dressage Preliminary 4 (2002) test. Horses were then ridden in either their normal bitted bridle in the test, or then in the other bridle repeating the test according to a random crossover selection decided by a coin toss. All subjects were videoed continuously from start of test until completion (approximately five minutes) allowing continuous and instantaneous behavioural data collection.

Each horse was ridden by the same rider for a 20 minute warm-up period in the Dr Cook™ bitless bridle to ensure that the bridle was not a novel addition during the test phase. The warm-up consisted of a period where each subject was ridden in the gaits of walk, trot and canter, and in both left- and right-handed directions around the arena as required by the chosen test. The 20 minute warm-up period was agreed following discussion with a qualified British Dressage Judge and British Horse Society Riding Instructor (McGuinness personal communication, 2011). This period accords with those used in published scientific papers regarding warm-up periods used in previous research with equines (Mehl *et al.* 2000, Balogh *et al.* 2001, Vervuert *et al.* 2005, Sloet van Oldruitenborgh-Oosterbaan *et al.* 2006).

The warm-up session took place in the same arena where the experiment was carried out in order to allow habituation to the presence of strange equipment and people around the arena area, with video camcorders already in place (see Figure 7) and assistants standing by the equipment.

Rider variability

The warm-up period was conducted by the same rider used in the experimental testing to ensure continuity and most importantly to avoid rider variability in order to eliminate the effect different riders can have on horses. Avoiding rider variability was an important part of the design of the study, as it is known in the research that follows the rider can influence the horse substantially. Edwards & Randle (2010) suggested that different rein tension pressure from riders actually influenced the stride and step length in a population of horses selected for similar ability. However there is a possibility that the riders were using stronger rein pressure as an aid to balance when the horses' gaits increased in speed, therefore rendering the results flawed. Another study also reported significant differences in rein tension as high as 15.5 Newtons between riders in a cohort of 46 horses and their riders (Glissmann & Konig von Borstel 2012), concluding that in both studies there were significant differences in the pressures experienced by horses depending on the rider used.

In another study it was found that horse falls in the cross country phases of eventing may be attributed to rider variability (Murray *et al.* 2006). This could be seen as additional evidence that riders have an influence on horse performance. These variables included riders who were aware they were in the lead at a certain stage of the phase, those approaching fences too fast, horse-rider combinations not having experienced a refusal at a fence and interestingly riders who received cross country tuition. Another study confirmed some of these findings, with rider falls increasing if they were aware of their leading position in the competition and also if they had received cross country tuition (Murray *et al.* 2005). It might be assumed that a trained rider would perform better than an untrained one, though it is possible these results

were obtained due to riders that had received tuition feeling braver in competitive situations because of their different training experience, and therefore riding faster over obstacles leading to more falls.

The impact of differences between riders also can be demonstrated in the interaction of different riders and the saddles that are used, as well as the actual skill levels of the rider involved. In a study examining saddles and riders of dressage horses the riders were shown to have a significant effect on the movement of the saddle (Bystrom *et al*. 2009). Research into the interaction with what was described as professional and recreational riders also demonstrated that the professional riders were able to adapt to a horse's movement pattern significantly quicker than the recreational riders (Schollhorn *et al.* 2006). Research comparing horses' heart rates, heart rate variability and behaviour found that a rider will influence but not totally mask a horse's innate behaviour while being ridden (Konig von Borstel *et al.* 2011).

Published findings from a range of studies (Scollhorn *et al*. 2006, Murray *et al.* 2006, Konig von Borstel *et al.* 2011) indicate that individual riders therefore do have a substantial impact on the number of aspects as reported, these including innate behaviour, adaptation to movement and motion of the saddle. As a consequence a single rider was chosen to perform on all the horses in all of the tests so eliminating any variables that might be associated with using different riders in this study.

The rider used in this research was a leisure rider and horse owner with 12 years of riding knowledge and practice with experience in a number of disciplines including endurance, show-jumping, eventing, showing at affiliated and unaffiliated levels. She is

currently completing a National Diploma in Horse Management and is a member of the International Society for Equitation Science.

Phases One and Two

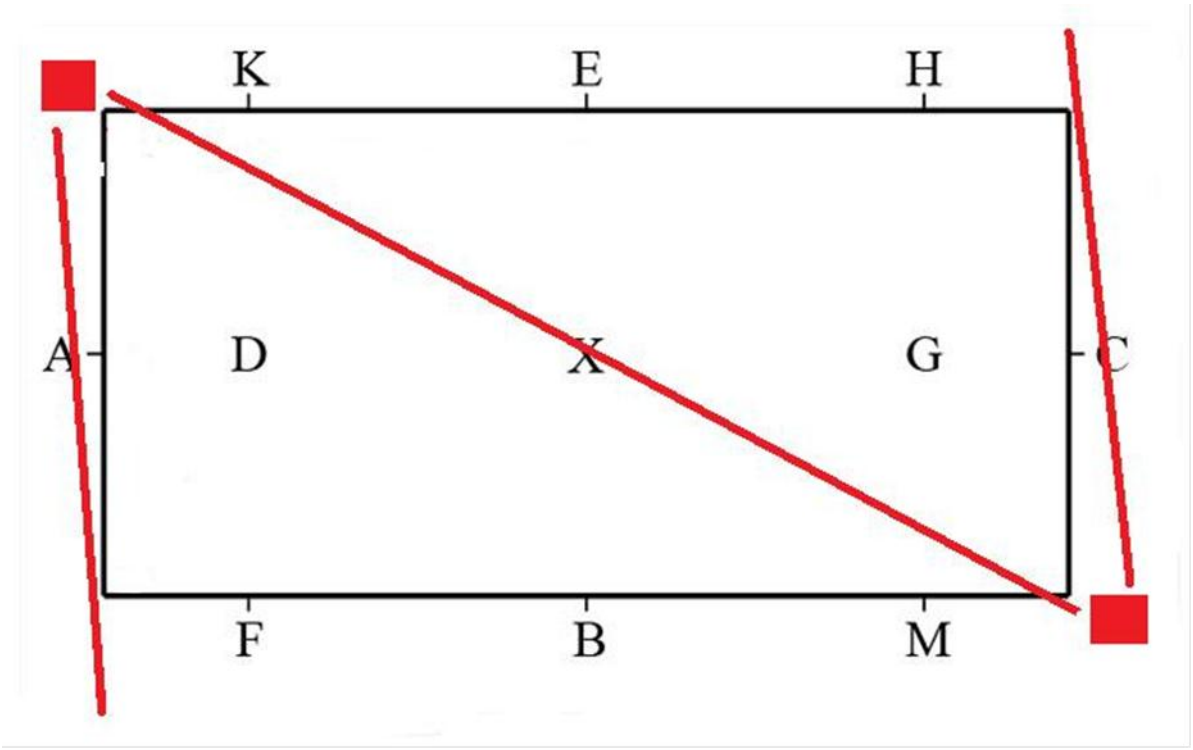
Phase One began with the Dr Cook™ bitless bridle either removed and the horse's normal (the one usually worn when ridden) bitted bridle fitted, or the Dr Cook™ bitless bridle staying in place according to the random crossover design. Immediately after completing the first test each subject completed the same test in the alternative bridle as Phase Two (see Table 10).

The random selection of bridles took place so horses were displaying behaviours that were not linked to familiarisation of the bitless bridle in every case (Martin & Bateson 2007). The dressage test began immediately after a circle to the starting point at X in each arena (see Figure 7). As soon as the horse began its test video recording started from the two points at each corner of the area and opposite to each other to obtain maximum and complete coverage of the exercise area.

Table 10 – Random crossover selection of bridles

Horse number	Phase One bitted	Phase One bitless	Phase Two bitless	Phase Two bitted
1	X		X	
2		X		X
3	X		X	
4		X		X
5		X		X
6	X		X	
7		X		X
8		X		X
9	X		X	
10	X		X	
11		X		X
12		X		X

Figure 7 – Layout of area showing line of sight for video camera positioning



Legend: where ■ = positioning of the two video cameras and ╲ = line of sight:

Data extraction

At the end of the experiments the behaviours performed and recorded were observed on a screen with projection from an Optoma DLP projector linked by cable to a Dell Inspiron 1545 laptop computer that ran the videos digitally recorded on SD Memory Card. The videos were watched by the author and an independent observer using the ethogram created for this research. The frequency of occurrence of behaviour was recorded using a tally system on paper for each horse whilst wearing either its usual bitted bridle or the Dr Cook™ Bitless Bridle and logged using the ridden ethogram. An inter-observer reliability comparison was used to determine any differences between the two observer scores. Differences in tallies recorded by the two independent

observers were found to be non-existent across the scoring sheets. Intra-observer reliability could have been influenced by what the observer was viewing, although it must be taken into account that the tallies matched the other, inexperienced observer's scores. The total number of behaviours exhibited was also recorded to ascertain behavioural intensity for both of the conditions. Since the data were non parametrically distributed (i.e. non normal) behaviours were analysed using a series of Wilcoxon paired t-tests on MiniTab v16 for PC. The Wilcoxon t tests were used to compare the occurrence of behaviours indicative of conflict observed when the horse was ridden in the bitless bridle and when the horse was ridden in the bitted bridle.

Results

Similar amounts of behavioural activity were observed with both bitless and bitted bridles in seven of the eight behaviour categories with the exception of tail swishing.

Non-significant behavioural activity

Table 11 – Non-significant behavioural activity

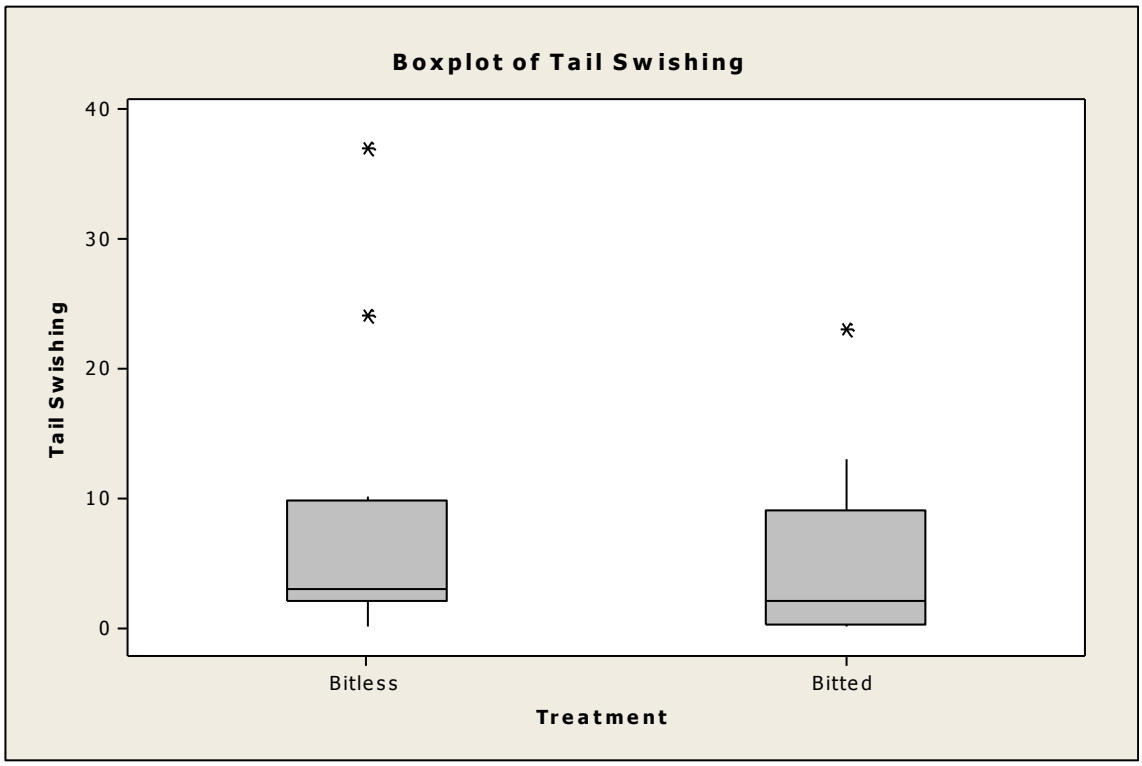
Non- significant behaviour observed	Result
Bucking	W_{12}=0.00; P>0.05
Cow kicking	W_{12}=1.00; P>0.05
Falling out	W_{12}=25.00; P>0.05
Hollowing	W_{12}=6.00; P>0.05
Overbending	W_{12}=2.00; P>0.05
Open mouth	W_{12}=14.50; P>0.05
Pull down	W_{12}=24.00; P>0.05

Significant behavioural activity

There was significantly more tail swishing observed with the bitless bridle (median occurrence/test =3.00; range 0-37) than with the bitted bridle (median occurrence/test =2; range 0-23; Wilcoxon T_{12}=1.00; P<0.05).

A box plot displaying the only significant behaviour observed was created and in shown in Figure 9 (below).

Figure 9 – Box plot of tail swishing



The observed behaviours with both bitless and bitted bridles are displayed in graph format as below (Figures 10 and 11 respectively).

Figure 10 – Behaviour observed with bitless bridle

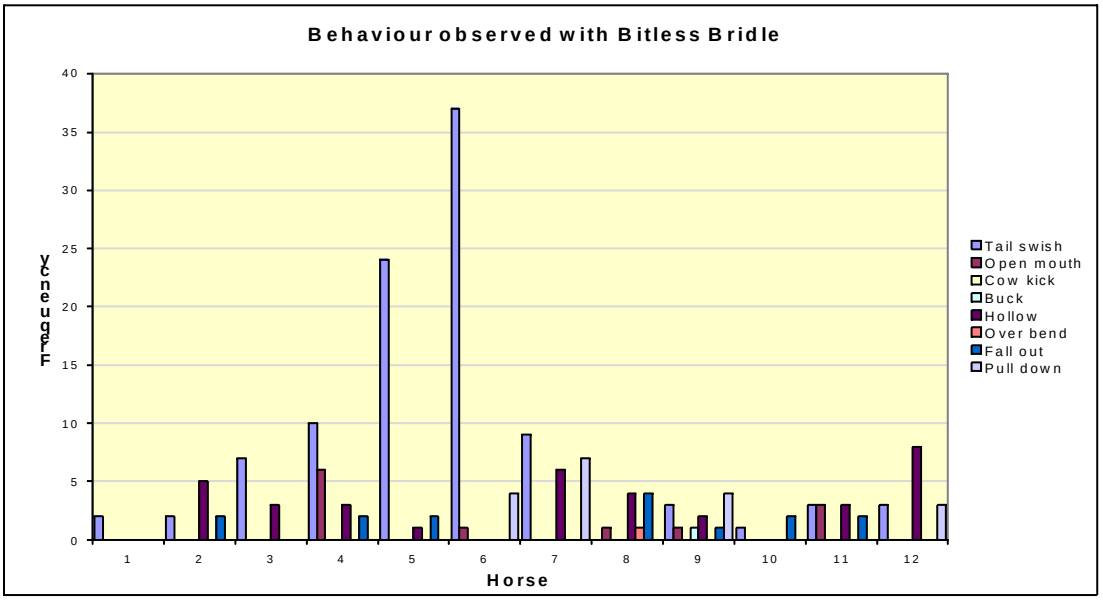
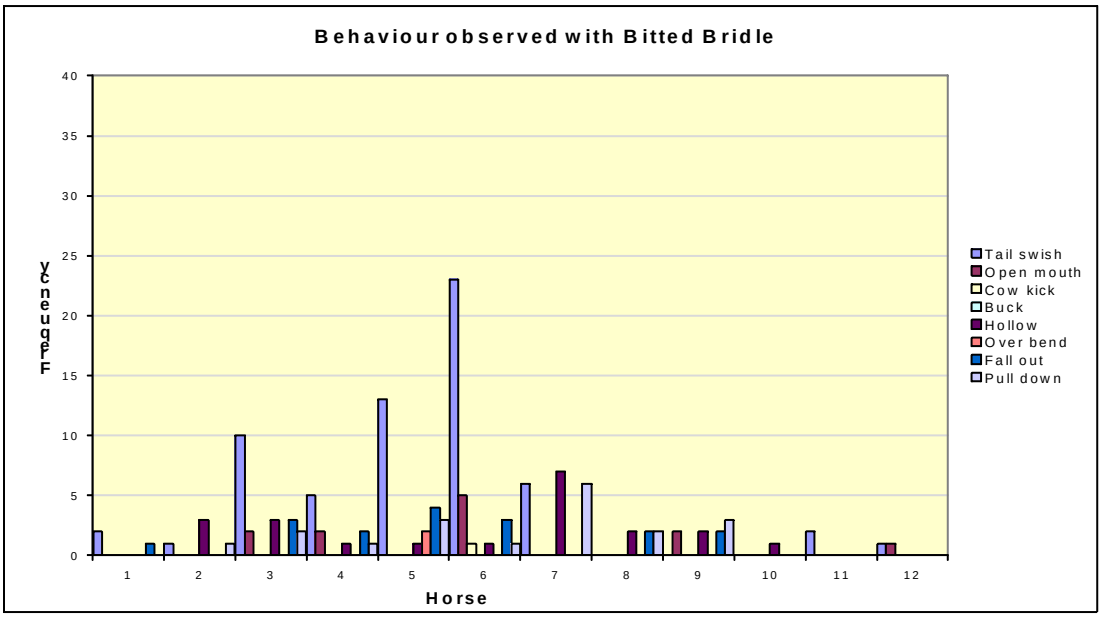


Figure 11 – Behaviour observed with bitted bridle



Medians to determine direction of difference

There was significantly more tail swishing with the bitless (median = 2 occurrences per test) than with the bitted bridle (median = 3 occurrences per test).

There was no significant difference in the remaining behaviours (Table 12).

Table 12 – Medians of direction of difference

Behaviour	Bitted median	Bitless median
Cow kick	0.00	0.00
Fall out	1.50	1.50
Hollow	1.00	3.00
Over bend	0.00	0.00
Open mouth	0.00	0.00
Pull down	1.00	0.00
Buck	0.00	0.00

Subjective comments

While experimental testing was being recorded, notes were also taken by the author concerning the behaviour of the horses as observed. The rider was also questioned after riding each horse to determine any comments she might want to add. Although these observations are strictly subjective, a table showing the rider's comments made appears below (Table 13).

Table 13 – Rider's comments

Subject number	Comments when ridden bitted	Comments when ridden bitless
1	Easier to collect	Subject heavier on forehand
2	Better canter, more balanced	More difficult to corner, fussier in mouth
3	Pulling and strong	Lighter in hand
4	Lighter in mouth	Hanging to left
5	Far better, much softer	Stiff and less supple on right rein
6	More forward going	
7	Rushed into gaits	Very responsive
8		Very heavy in the hand, falling into canter
9		Better canter, easier to manage stride length, less strong
10	More forward	Less balanced, felt confused, not rounding
11	Forward going, collected	Worst feeling with this subject, felt unbalanced and even lame
12	Stronger in canter but more supple and bent easier	Relaxed

The legend for table 13 appears below to explain the terms used.

Table 13 – Legend for terms used in table 12

Term used by rider	Explanation
Collect	rider's perception of being able to control both the horse's head and the horse's body at the same time
Forehand	rider's perception of the horse leaning on the reins in a given gait
Balance	rider's perception that the horse is presenting a compact controllable shape
Lighter in hand	rider's perception of the horse's reins becoming less heavy and the head feeling balanced
Lighter in mouth	as above but rider able to distinguish lightness in the mouth
Hanging	horse leaning its head and/or body to the left or right
Right rein	when the horse is proceeding clockwise around the arena
Forward going	rider feels the horse is moving forward in its gait without having to use negative reinforcement in their leg signals
Rounding	horse responding to rider's signals and increasing curvature of the spine, lowering the head and bringing its hindquarters under its body
Bent	horse responding to signal from rider to lower its head and bring it towards its neck

Comments by the author as written on the second observation day 14.10.11:

"*I am beginning to notice that some horses move their heads side to side when first in the bitless bridle as if they are searching for the bit. Four have done this today out of a group of five. Another one was performing this action when first put in the bitless bridle. Thinking that horses who are usually classed by students/owners as 'strong'*

seem to go better in the bitless. Two horses in the whole cohort had strong reactions – Subject 11 looked very unbalanced and uncomfortable, and Subject 12 appeared relaxed and moved extremely well."

Chapter 3 Discussion

Study One, the qualitative questionnaire, was designed to address how to describe and profile the leisure rider who was used during the piloting of Study Two, which was the original experiment. Study Two with its question of whether there is a significant different in behaviours exhibited by horses wearing bitted and bitless bridles needed this definition in order to fully describe the rider used.

The profile of the leisure rider as defined in Study One was found to correlate with Muller's statement (2010) of using horses for pleasure and relaxation, attending local shows and to improve their riding and level of training. Aspects of the significant result from the bitless bridle experiment add weight to the discussion over its use by leisure riders, and their access to professionals regarding advice and guidance.

Results from the observations of exhibited behaviours between horses wearing bitless and bitted bridles suggest that a comparison of conflict behaviour exhibited between the bridles has this single significant result in tail swishing occurrence only. Conflict behaviour and stress responses in horses are however difficult to catalogue, and it can be seen that the literature is not immediately supportive of the descriptions of conflict or indeed stress behaviours. The lack of information on these types of behaviour do compromise the findings of Study Two, although a small range of research does describe its only significant behaviour, tail swishing, in their repertoires of described conflict behaviour (Quick & Warren-Smith 2009, Hockenhull & Creighton, 2008). Tail swishing as a single reported conflict behaviour also appears in a study by Konig von Borstel (2012), where horses were introduced into a Y-shaped maze, and also in a very

recent study by Link and Kienapfel (2013). This latter study reported on dressage horses ridden in warm-ups before competition, and found that horses scoring the lowest number of points in the following tests exhibited more tail swishing than horses scoring higher.

Other behaviours shown do not have a significant difference in observations with horses ridden in either bitted or bitless bridles. Tail swishing as reported is represented in the British Dressage rule book in its own heading of "Teeth Grinding and Tail Swishing" under the section "The Arena and Riding the Test" (British Dressage 2012):

"*Grinding the teeth and swishing the tail may be signs of nervousness, tenseness, or resistance on the part of the horse and can be taken into account by the judges in their marks for the movements concerned as well as in the appropriate collective mark at the end*."

The study carried out by Quick and Warren-Smith (2009) recorded details of behavioural observation, and included tail swishing. It was reported in the Quick and Warren-Smith study that subjects trained in the bitted bridle displayed significantly more tail swishing than the group trained in the bitless bridle. It may be that the subjects responded differently because the cohort chosen for the study were receiving foundation training and were all young horses who had not experienced the variability of many different riders, bits and bridles over their lifetime. The young horses would have been trained to accept a head collar either before or during the first part of their foundation training, and so were totally naïve to the experience of having a bit inserted in their mouths. It could be this factor that gave rise to the significant

increases in tail swishing, as the novel experience of the bit may increase any type of behavioural response in the study subjects. This response indicator could also be referred back to welfare issues in the training of the young horse, and the care needed to ensure that the first introduction of the bit is taken in stages with systematic desensitisation.

Another comparable behaviour in the Quick and Warren-Smith study (2009) concerned subjects opening their mouths, and it reported that the cohort trained in bitless bridles demonstrated a significantly lower level of this behaviour than the cohort trained in bitted bridles. Again this is found to be different with the cohort of more experienced horses used in the author's study, as the behaviour of opening the mouth showed no significant increase in behavioural frequency across the two phases of subjects wearing bitted or bitless bridles. It is possible that the exposure to bitted bridles of the young group of horses in the 2008 study could again be seen as a novel event and affect results of behavioural observation for this particular cohort.

Care however must be taken in accepting the significance in the single behavioural frequency of tail swishing in the author's study as evidence of a welfare issue in using bitless bridles. It has been reported that single identifiable behaviours such as tail swishing in mammals are usually observed as representing one key element of the function behind that particular behaviour (Fureix *et al.* 2011), whereas it is the whole posture of the subject that should be considered. In the author's study eight behaviours were categorised as being evidence of conflict behaviour, as single episodes of occurrence only, and therefore the full body posture was not considered in its entirety. This could present problems of correct behavioural observation in this and

many other studies (Visser *et al.* 2003, Licka *et al.* 2004, Quick & Warren-Smith 2009, Nyman *et al.* 2010), where objective studies are based around single behaviour frequencies. The observation of the subjects in the author's study did take place in the field as well as independent tallying by video after the events; however it was reported that single behaviours were sometimes difficult to calculate on a moving image that could not be slowed or stopped with any accuracy.

Other factors to be considered include the number of and range of subject used, and whether a study with a higher sample size could affect the results. Range of subjects could extend to horses that have experienced affiliated competition, or selected by breed, age or sex. The results of a single behaviour may well then extend to include further behaviours exhibited by horses experiencing higher levels of stress at competition, or indeed less behaviours because of an advanced level of training. It would certainly be interesting to create and then compare a profile of an experienced rider to that of the leisure rider in all the many aspects discovered.

The concept of using a holistic approach to observing behaviour in horses ridden in bitted and bitless bridles could be used in a future experiment and would provide a completely different, more robust categorisation of observed behavioural frequency. This holistic approach could also include the measuring of heart rate and rein tension as further indicators of stress behaviour.

Results reported in the study by Cook and Mills (2009) did not include specific behaviours but instead took subjective comments from a dressage judge who also gave a score to each movement horses performed in a ridden test on a scale of one to

ten, where ten was optimal. Horses (n=4) were ridden in bitted bridles and then bitless bridles of the Dr Cook™ cross under design and their scores contrasted. The results from the study found that a significant number of subjects scored higher in those tests where they were ridden in bitless bridles. However due to the subjective collection of data it is very difficult to compare these results objectively, though it can be stated that because this study relied on the subjective collection of data it may have been influenced by the observer's own biases.

Other subjective comment in the Cook & Mills (2009) paper stated that every horse accepted the fitting of the bitless bridle after their bitted test and preceding their bitless test "…without hesitation…" The subjects were fitted with the bitless bridle immediately after their bitted bridle was removed, and as no random crossover selection was made, this was concurrent with every horse. It is possible that naïve horses who have not had a bitless bridle fitted before (as stated in the Cook & Mills study) may easily accept a bitless bridle without hesitation as being similar to a head collar, with no need for the handler to open the horse's mouth to insert a bit. The lack of randomisation of test subjects with either bitless or bitted bridle is seen as a significant event in the results obtained by Cook & Mills. When the visual evidence of the Cook & Mills study is also observed, it can be seen that a great deal of activity surrounds the experiment, with horses being ridden in the background in the same arena. These horses are present when the bridles are being changed, and could contribute to the lack of reaction given by the horses when they were fitted with the bitless bridle for the first time, perhaps where the subject horses were distracted by these events.

The results of the author's study also included subjective comments collected from the rider concerning each horse after the two phases were completed. These were included in the results section due to the interesting ideas raised by the comments, which could be used in a future study if a procedure for observing them as objectively as possible could be made. The rider commented in favour of the bitted bridle in all but two subjects, where she found that the bitless bridle improved the way the horse responded to pressure. It is interesting to note that these two horses are both college horses known anecdotally by students as both being slow to respond to the rider giving a stop cue through the reins and bit. Horses displaying these tendencies may be more responsive in a bitless bridle owing to the lack of signal from the bit, and the differently placed novel signal of pressure to the head. Future study could include the collection of objective data exploring this occurrence to gain some insight into whether this is indeed an observed effect.

Rider comments concerning the other ten subjects included mainly damaging reflections of the bitless bridle, including lack of response to the cues given. This could possibly be attributed to the horse having difficulty interpreting the different signals from the bitless bridle, with only head pressure instead of bit pressure. A horse experiencing the novel sensation of a bitless bridle may well be confused by the interpretation of the unusual signals from the rider. One subject in particular gave the rider the feeling that it was lame when ridden in the bitless bridle. This subject, Horse 11, was one of the original horses based at the college having come from an army career. It is thought that the horse might have had this reaction to the bitless bridle due to its being ridden in a double bridle for much of its life, and therefore very unused to the lack of pressure in its mouth. However this was not comparable to the

objective results excepting the significant increase of tail swishing observed in the bitless bridle.

Subjective comment from the author was also included in the results as on a particular session it was noticed that many of the horses displayed the same types of behaviour when wearing the bitless bridle for the first time. It was described as a lateral movement by the head and neck while the horse was waiting to be mounted for its warm-up period. It was supposed that the subjects, being used to a bridle having a bit, were actively searching for this part of the bridle when it was placed on the head. It has been noticed and reported anecdotally that some horses will readily open their mouths when the bit is presented to them, although after an extensive search there appears to be no investigation of this behaviour in literature.

It was also mentioned that the author agreed with the rider in the observation of some subjects known as unresponsive to the bit as being more responsive in the bitless bridle, and also that two horses in that particular session had strong reactions to the bitless bridle; one seemingly moving with more coordination in its paces and the other displaying a lack of balance. It is interesting to note that the comments written by rider and author correlated, although these are only subjective. Future research could find an objective way of observing these reactions in subjects by taking into consideration a larger spectrum of holistic postural behaviour correlated with observation of the horses ridden in college lessons.

The use of a bitless bridle in dressage tests has been suggested in order to improve welfare due to the results of the Cook & Mills' study (2009) reporting that the dressage

judge used rewarded higher points to horses wearing bitless bridles. The welfare concerns in Cook and Mills' study were reported to centre on the presence of the bit in the horse's mouth, and the possibility of injury and discomfort to the diastema, hence the use of the bitless bridle acting only on the nose and/or cheeks and poll of the horse. However the significant increase in tail swishing observed in the author's study would indicate that the bitless bridle does contribute to an increased possibility for a horse and rider combination to concede marks in a dressage test with the presence of tail swishing. However, if the occurrence of a single conflict behaviour in the author's study is seen to increase with the use of the bitless bridle, there is another factor or factors involved beyond the action of the bit itself, and potentially with the extra pressure on the head and in particular possibly the noseband.

Recently aspects surrounding the tightness and positioning of the noseband section of a bitted or bitless bridle has become popular. The use of a noseband is linked to a practical response from riders and trainers of horses to use them as devices to stop a horse opening its mouth while being ridden (McGreevy and McLean 2010). It has been reported that the opening of the mouth is also detrimental to scoring in International competitions and has increased the use of nosebands to clamp the jaw shut to stop horses opening their mouths (McGreevy *et al.* 2012). The Dr Cook ™ bridle utilises a noseband to control a horse's forward movement by a cross-under strap exerting pressure on the muzzle and then releasing with movement of the rider's hands on the reins. Tightly fitted nosebands have recently been reported to cause a reduction in blood flow and an increased physiological stress response and additionally contribute to sensitivity within the mouth (McGreevy *et al.* 2012). In a study on variables affecting racehorse performance the use of a grackle or figure of eight noseband (both typically

used to keep the mouth from opening and to fix the bit higher in the mouth to avoid evasion) on horses was a significant predictor of failure on the racecourse (Hutson 2002). It is possible then that the bitless bridle, by using the action of a noseband to apply pressure, may actually be detrimental to equine welfare rather than support it.

The Dr Cook™ design relies on the release of the tight noseband by the rider's action on the reins, so the release of the pressure acts as a reward in negative reinforcement. However McLean stated in 2012 that pressure itself motivates and not trains, therefore raising the issue of whether the horse is merely responding to the pressure to stop rather than learning to stop when it is applied. It has been anecdotally observed in the author's study that the design of the Dr Cook™ bitless bridle sometimes seems to delay or even stop the release of the cross under noseband when the rider releases pressure on the reins, therefore itself creating a possibility for unwanted behaviour to occur as pressure is not released immediately. A similar effect is created when using a halter for leading a horse, and in particular the Dually™ design that relies on pressure release to motivate the horse to stop (McGreevy and McLean 2010). However if the release of pressure is not happening due to the delayed function of the bitless noseband it could explain the significant behaviour of tail swishing displayed by horses in this study. There is a need for further study to take place regarding the effect of nose band tightness on ridden leisure horses as there is an apparent welfare consideration reported on in literature regarding competition horses (McGreevy *et al.* 2012).

The leisure rider profile built up a characterisation of a rider that was very similar to Muller's explanation (2011), with hacking on roads taking a major part in this type of

rider's experience. The trend of having lessons, but not schooling their horses on their own provided a view into the perceived lack of riding confidence of the leisure rider, which is not comparable to their sound confidence in deciding to try out novel tack and equipment. This aspect of confidence in trialling new equipment is worrying when looking at the incidence of these riders using bitless bridles. It seems that the welfare of their horses could be compromised if at one level the leisure rider decides they are not skilled enough to school a horse on their own, but find at another level they can trial potentially harmful items of tack and equipment.

Leisure riders answering questions about tack (the saddle, bridle and other items used in riding horses) reported that the most frequent item purchased or borrowed was the bridle, although the incidence of nosebands appearing in the descriptions were lower. However, as the bridle is the most frequent item, leisure riders are obviously interested in some aspect of replacing it on a more regular basis than other types of items. This could be due to trialling different types of bridle, or indeed different component parts including the noseband. The fact that the noseband was purchased separately does suggest that the incidence of experienced and professional riders using many different types of noseband could have an effect on the unskilled leisure rider population. In addition, the second most purchased or borrowed item was the bit, and this proves even more so that leisure riders are trialling different bits, with a potential for real welfare concerns. However it has to be considered that leisure riders could also be replacing worn out items of tack when reporting on purchases, although not in the case of borrowed items. It would be beneficial if a further study could identify the reasons why a participant bought or borrowed the piece of tack in order to derive the reasons for doing so.

When leisure riders reported on their use of bitless bridles a significant number had not ridden in a bitless bridle with various reasons given either for using or not using one. The most common reasons to use a bitless bridle were grouped into aspects concerning the health of the horse. Health reasons indicated that horses ridden by leisure riders were experiencing dental problems and/or mouth lesions, and it was decided to trial a bitless bridle. This issue is not considered a danger to the horse's welfare if advice from a professional suggested trialling a bitless bridle, although it was not clear in the questionnaire whether it was the participants' own decision or advice given to them. Further study would enable this aspect to be made clearer, and a welfare issue might then be raised due to the inexperience of the leisure rider's choice of equipment.

Leisure riders reported the next reasons as the fact that the horse they rode was already wearing a bitless bridle. The third reason was reported by the rider as wanting to experiment with one, though not giving a reason why, and this is of concern regarding the experience of the leisure rider. It was reported in the questionnaire that a significant number did not possess any equine qualifications, and therefore may not possess the knowledge required to decide on the type of bitless bridle to use and how to fit it. However, the lack of qualifications held by leisure riders is only troublesome if problems that are experienced are handled without recourse to a professional.

A report by Hockenhull and Creighton (2012) using a web-based questionnaire reported that 91% of leisure riders stated they had experienced behavioural problems of varying types with their horses in the week before they completed the questionnaire. This can only be seen as a danger to rider safety if the riders are not

contacting professionals for retraining and advice. It would be useful to ascertain if those leisure riders experiencing problems did then contact a professional, otherwise the study results can state only that there is potentially a concern for safety. Within the leisure rider population it can be reported that there are potential problems surrounding the inexperienced use of items of tack including bitless bridles, but possibly this only presents a problem if such riders are not contacting professionals for their advice.

Experience and training were also investigated in the qualitative questionnaire section of the study where Muller's statement of the leisure rider (2010) included information about their use of horses for pleasure but did not mention their taking part in any type of training. There seems to be confusion within the equine industry regarding the categorisation of leisure riders, semi-professional riders and professional riders and whether it is the aspect of experience that defines them. A study for the United Kingdom government reported that the categorisations overlap, and stated a distinct lack of evidence to suggest exactly what determines each type of rider (www.bhic.co.uk 2004). The report did however place riding lessons in the leisure section of the industry, perhaps suggesting that it is thought leisure riders take part in lessons, while professional riders have more specific training. Certainly it was found in the qualitative results that a significant number of participants in the questionnaire attended lessons with a qualified instructor, but this could also easily be applied to the professional riders concerned in the Government study, though it does not provide any explanation of the difference between lessons and training. The qualitative study did however report that there were a significant number of leisure riders who did not school their own horses; perhaps illustrating that where training their horses is

concerned leisure riders do prefer to take advice from riding instructors in the form of lessons rather than relying on their own knowledge. A leisure rider may not have the confidence to train their horses individually without a professional being present to correct any mistakes.

It was also stated by Muller (2010) that leisure riders might attend local shows for enjoyment and experience, and certainly there were a significant number of participants reporting that they did attend local shows in the questionnaire. The content of local shows is based around three disciplines, those of showing your horse in either ridden or led in hand in classes depending upon how it is kept and what breed it is, a section of classes where demonstrations of ability including jumping are given, and a section for younger riders to take part in games commonly known as a gymkhana. It is thought that attendance of local shows gives leisure riders the experience of competing at a very low level with their horses just for enjoyment and as part of the equine experience.

The next question asked if participants took part in affiliated competitions, where the character of the leisure rider changes into the more competitive semi-professional rider. Results indicated a significant number of participants that did not attend affiliated events, thus suggesting that the leisure rider does not take part in these activities. Therefore attendance at local shows could give leisure riders the ability to gain experience in riding, and possibly to use this to their advantage when taking part in riding lessons. Perhaps the cross over point of leisure rider to professional rider happens at this stage, where success at showing locally moves onto attendance in

affiliated competitions, and the rider progresses out of the character of purely leisure rider.

The degree of knowledge a rider holds may also point towards their categorisation of leisure rider rather than professional. In the questionnaire it was reported that significant numbers of participants held what they considered was an average level of knowledge in all the subjects indicated of husbandry, tack/equipment, feeding, health, worming and shoeing. Worming and shoeing results demonstrated where leisure riders considered they had the least amount of knowledge. This result could be seen as an aspect of rational thinking in the case of shoeing, where shoeing itself can only be carried out in the United Kingdom by qualified practitioners. However it creates an amount of concern for welfare of the horse when one of the practical tasks undertaken would be to check the condition of a horse's feet before it is ridden. The lower than average results regarding worming knowledge could be seen as very concerning, where a survey conducted by Allison *et al.* (2011) reported that less than 50% of the population of leisure riders responded that they contact a veterinary surgeon for advice on worming. Other professionals may indeed have been consulted, although this was not reported.

The highest above average score given by leisure riders concerned husbandry, which is considered by an examination board as including environmental care (stabling, bedding) and personal care (grooming, trimming and clipping coat hair) (Edexcel.com 2007). This result may be because leisure riders have an interest in the care of the horses they ride, or due to equine magazine coverage of many aspects of husbandry in the articles they publish. However, comparing the fact that a significant number of

leisure riders reported that they had no qualification in equine subjects raises the question of whether if tested the knowledge would be correct and/or current.

The highest average score reported that 75% of leisure riders considered their knowledge of feeding to be at this level. Feeding and nutrition is heavily advertised in equine popular magazines, and there is great choice in the different types of foodstuffs. One such choice centres on the geriatric equine population, where it was reported that owners of such horses changed feeding practices significantly when the age of the horse concerned reached 15 (Ireland *et al.* 2011). There are many types of feed advertised specifically for the geriatric equine population, and many of these are marketed to be fed to horses over the age of 16. With this fact in mind, leisure riders are responding to advertising by choosing feeds based on the age of their horse, and with a higher level of education may realise that this is not the only criterion for ensuring a complete level of nutrition for their horse.

Another possible indicator of the character of the leisure rider comes in the results regarding hacking demographics. It could be considered that expensive competition horses might not be risked on the public road system, and therefore leisure riders complete a large amount of their riding time budget in hacking on roads. It has been reported that horse riders are involved in a significant number of accidents and near accidents on the road systems in the UK (Chapman & Musselwhite 2011) so therefore riders do expose themselves and their horses to risks when riding on roads. In the questionnaire a significant number of respondents did choose to ride their horses on the roads, regardless of studies such as the one above and also plenty of anecdotal evidence discussed between riders of accidents they have heard about or experienced.

There could be a number of reasons why leisure riders feel they need to use the road system, especially as it was reported that a significant number did not school their horses, so using hacking as exercise as well as for enjoyment. These reasons could include the lack of off-road riding in their area and the necessity of using the road to access other permissive tracks and bridle paths.

Rider perception of the road being a safer place to ride than a field could also account for the greater use of roads for hacking. It has been reported that horses demonstrate different temperaments (Visser *et al.* 2003, Visser *et al.* 2008, Konig van Borstel *et al.* 2011) and that purchase of a certain type of horse is affected by the perception of its temperament (Hennessey *et al.* 2008). More emotionally reactive horses have been reported to trial significantly more evasive behaviours (Visser *et al.* 2008) and this could translate to trialling these behaviours in situations where there are large expanses of grass. Anecdotally, riders comment on certain horses reacting to grassed surfaces by speeding up their gaits and seeming to want to increase their speed, therefore riders using road work to avoid this situation. Further research into questioning leisure riders on their reasons for using roads could reveal data to explain attitudes to road use and also possibly ways to improve the safety of the majority of leisure riders who ride on public roads.

Chapter 4 Conclusion

The leisure rider profiled in Study One has been characterised as a rider who lacks the official qualifications of the educated professional, though not necessarily the knowledge. Leisure riders may defend their position by stating that in circumstances where they do need assistance they will seek the advice of a professional, although this was able to be not proven here due to lack of specific data. The tack and equipment used by leisure riders was stated to include the use of bitless bridles, although perceived popularity and common use of bitless bridles are disputed in this study where a significant number of leisure riders have not used one on the horses they ride. The use of the bitless bridle did produce comment and observation from participants when mentioned in the survey, and it can be seen that further research in many areas is needed. Leisure riders do trial bitless bridles, and if they cause a significant increase in behavioural frequency of even one observed conflict behaviour leisure riders do need to consider on welfare grounds whether to trial one without asking advice from a professional.

The discovery of this significant conflict behaviour of tail swishing in Study Two shows there could be a welfare issue to answer in regards to the Dr Cook type of bitless bridle. The long term effect of a horse wearing the Dr Cook bitless bridle might be an issue to investigate in the future, although the practicalities of such a study may be insurmountable. However, the possibility of examining parts of the bridle that might be contributing to the significant conflict behaviour discovered is very interesting. A study into the action of the noseband on the Dr Cook bitless bridle could provide clues to the perceived delay in release of pressure on the muzzle once the rider has signalled

the horse to stop. Persistent negative reinforcement experienced by a horse wearing this type of bridle might explain the significant behaviour shown, and could show the Dr Cook bridle to be a type of bridle that does indeed compromise the welfare of the horse wearing it.

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