Original article

Measurement of bit-pain in the ridden horse

WR Cook[1]

ABSTRACT

Between 2002 and 2008, using a psychometric approach, 56 controlled experiments with one variable were conducted by riders who switched their horse from a bitted to a bitless bridle and documented before-and-after behavior. Riders entered data on a prototype questionnaire listing 86 unwanted behaviors in 8 categories. They first checked, in column one, the behaviors they had recognized since owning the horse when worked in its usual bitted bridle. In column two, after similar work in a crossunder bitless bridle, with the same rider, they checked the behaviors again. The horses were of different ages, breeds and disciplines. The median number of unwanted behaviors was 32 when bitted and 2 when bitless. Not less than 88% of the total unwanted behaviors for the study population were caused by the bit. Bit-pain was measured by assigning a score of one to each behavior and subtracting the bitless score from the bitted. The raw, median pain score was 30. The final bit-pain score for an individual horse was prefaced by the length of time that had elapsed before the second column was completed. The unwanted behaviors eliminated were anomalous but nevertheless physiological responses to pain and fear. They included many that result in accidents and injuries to horse and rider. All 56 horses failed to 'accept' the bit. The unwanted behaviors were classified as stereotypies. The study showed how, with a standardized psychometric questionnaire, practitioners and their clients could together make a contribution to evidence-based medicine.

KEYWORDS: *pain, stereotypies, behavior, bit, bitless, horse*

INTRODUCTION

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In human medicine, pain constitutes the fifth vital sign and a patient's subjective evaluation is recorded on a numeric scale from zero to 10. In veterinary medicine, no such evaluation is possible. Nevertheless, in the last 30 years, with an increased interest in animal welfare, many studies of pain have been undertaken. A review of equine pain (Ashley et al 1985) reminds us that, apart from lameness, most attention in the horse has been paid to pain at rest rather than at exercise. Though the review was wide-ranging, the effect of the bit was limited to a passing mention of '*bad bit behavior*.' More recently, in a review of undesired behavior in horses, the word 'bit' does not appear (Hothersall and Casey 2012). Again, the bit was not listed as a risk factor in a study of misbehavior in Pony Club horses, even though the word 'bit' featured in 4 of 30 '*unwelcome behaviors'* (Buckley et al 2013). The veterinary profession as a whole seems to have 'accepted' the bit in much the same way that most riders and equestrian administrations expect the horse to do the same. That said, there are exceptions. The first line of a treatise on bits stated, *"One of the greatest evils and abuses of the horse … is the biting"* (Clark 1835). Today we speak of 'bitting' rather than 'biting' but Clark reminds us that the word bit is derived from the verb 'to bite.'

As pain is a subjective experience, its direct measurement is impossible. There is no unit of pain. Nevertheless, as pain is expressed through behavior, a measure of behavior can serve as an indirect measure of pain.

The horse is one of the least likely animals to be selected for research on any topic but, paradoxically, it represents an unusual opportunity for research on pain. Since the Bronze Age metal rods have been routinely inserted in the oral cavity of an exercising horse and used as pressuring devices. A survey of horse skulls showed that bit-induced dental erosion and mandibular osteitis (bone spurs on the bars of the mouth) is common (Cook 2010). As the bit is an evident cause of pain, the unwanted behavior it provokes can be measured by studying the improvement in behavior brought about by removing the bit. The development of the crossunder bitless bridle (Cook 1999) has made possible such measurement as horses can be switched instantly from bit to bitless without the need for transitional training.[2] Before-and-after behavior can be readily compared as each horse acts as its own control.

The effect of a metal foreign body in a horse's mouth at exercise was first assessed by Quick and Warren-Smith (2009). Using two-year-olds, they compared 23 behavioral responses in two bitted horses with two bitless ones, over an 11-day period of foundation training. The two bitless horses *"performed at least as well as, if not better"* than the two bitted horses. Cook and Mills (2009) showed, with an experiment in which bitted vs bitless behavior in four mature horses (performance in a dressage test) was compared and scored by an independent judge, that in the riders' and horses' very first four minutes of being bitless, average scores rose from 37 (bitted) to 64 (bitless) - a 75% improvement.

The primary objective of this article is to apply psychometrics to the measurement of pain in the horse. Psychometrics is a field of study generally associated with psychological measurement

[2] Note for reviewers: The term 'crossunder bitless bridle' is a generic term and carries no more proprietorial meaning than the term 'snaffle.' Like the snaffle, there are many versions of the crossunder bitless bridle now on the worldwide market.

in man but, as Reid et al (2013) have stated, *"… this approach can be used to produce scientifically robust pain scales for non-human species."* The need for the development of health-related measures of the quality of life for horses has been emphasized by Muir (2013). The present article collates the reports from 56 riders who, in a series of 'natural experiments,' switched their horse from a bitted to a bitless bridle**.**

A secondary objective is to show how a psychometric questionnaire may be used to develop evidence-based data.

The experiments tested the null hypothesis that the number of unwanted behaviors of the ridden horse would not change when a bitted bridle was replaced with a crossunder bitless bridle.

The word pain is used to include both physical and mental pain, i.e., pain and distress

MATERIALS AND METHOD

During the years 1999-2003, feedback from bitless riders was used to develop a data base of the behavioral changes observed when a horse was switched from bit to bitless. In 2004, this was developed into a structured questionnaire (Cook 2007a-c). The questionnaire was tested between 2004 and 2008, by 86 volunteers. 56 of the returns were eligible for analysis.

The questionnaire started with line items about the signalment and history of the horse, followed by 86 questions, mostly about behavioral items (Table I).[3] 72 of the line items referred to unwanted behaviors of the horse and 10 to the horse's feelings as reflected by the rider's feelings. Riders first checked, in column one of the questionnaire (Table II), the line items they were familiar with when riding their horse in its customary bitted bridle. In column two, they checked the list again after similar work in a crossunder bitless bridle.

- The second column was completed after horses had been bitless for periods ranging from one day to 2 years (median 3 months)
- Each unwanted behavior was assigned a numeric value of one.
- The raw bit-pain score was arrived at by subtracting the number of unwanted behaviors when bitless from the number when bitted.

In the sample questionnaire (Table II), 9 unwanted behaviors when bitted minus 2 when bitless gives a raw bit-pain score of 7 (see 'Results' for comments on 'raw').

[3] See attached Excel file

CATEGORY (Each 'yes' answer was assigned a numeric value of one)	A BITTED Y/N	B BITLESS Y/N	Raw BIT-PAIN SCORE (A-B)
FEAR			
FRIGHT: Spooky, shy	Y	N	X
FLIGHT: Bolting, rushing	Y	N	X
FIGHT: Resistant, slow response to cue	Y	N	X
FREEZE: Napping, planting feet	Y	Y	
OTHER RISK OF ACCIDENTS			
Difficult to mount, fidgety	Y	N	X
Bucking or bounding	Y	N	X
Rearing	N	N	
Falling down and sudden death	N	N	
Difficult to steer, 'lugging'	Y	N	X
Premature fatigue	Y	N	X
Stumbling	Y	Y	
TOTALS	**9**	**2**	**7**

Table II. Sample questionnaire

THE QUESTIONNAIRE

Unwanted behaviors were listed in eight categories (Table III). The behaviors ranged from the regrettable to the life-threatening.

1	FEAR: Fright, flight, fight, freeze
2	Other warning signs of heightened risk
3	Anxiety before riding and discomfort after
4	Signs caused directly by the bit
5	Signs consistent with trigeminal neuralgia
6	Interference with breathing
7	Interference with stride and schooling problems
8	Rider's feelings

Table III. The eight-category questionnaire

The complete questionnaire can be downloaded from
http://bitlessbridle.com/FOTB_Q.pdf

THE RIDERS

As part of the package, all users of the 'Dr.Cook®' crossunder bitless bridle (BitlessBridle Inc. 1200 Nursery Road, Wrightsville, PA 17368 USA) were invited to complete the questionnaire. The volunteer responders were not otherwise selected or pressed and they lived in many parts of the world.

THE HORSES

AGE	Median 8 years (range 3-24 years)
BREED or TYPE	Diverse (mainly Thoroughbreds and Warmbloods)
GENDER	36 geldings, 20 mares
TIME OWNED	Median 2 years (range 9 months to 21 years)

Table IV. Signalment of the study population

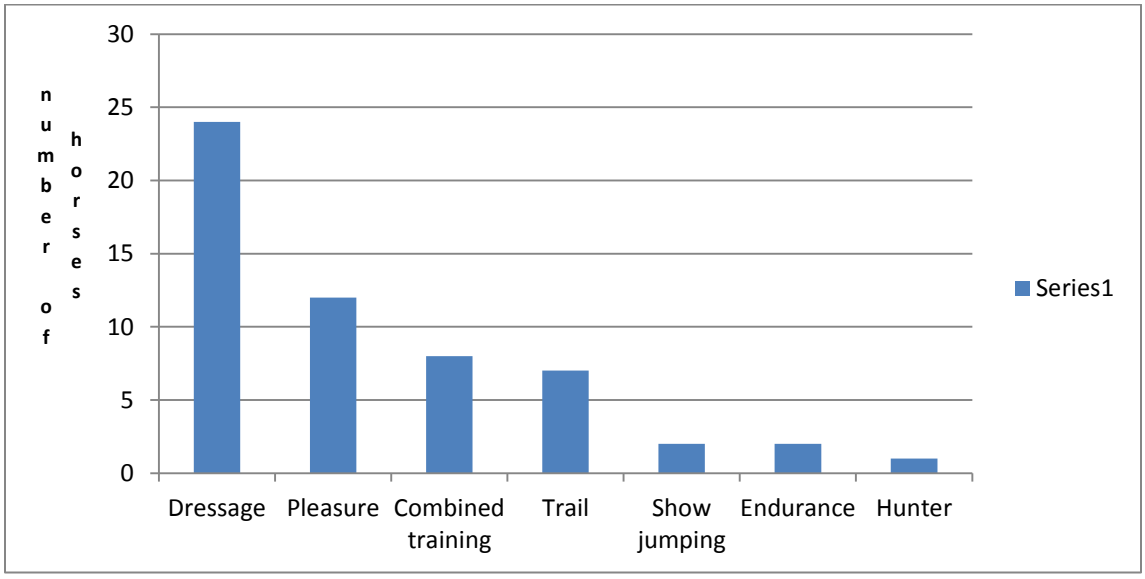

Figure 1. Population demographics by discipline

43% of the 56 horses were used for dressage, 20% were pleasure horses and the rest were used for other disciplines. A variety of bits had been used.

RESULTS

55 out of 56 horses showed significantly fewer unwanted behaviors when bitless (Fig.2). The null hypothesis was refuted.

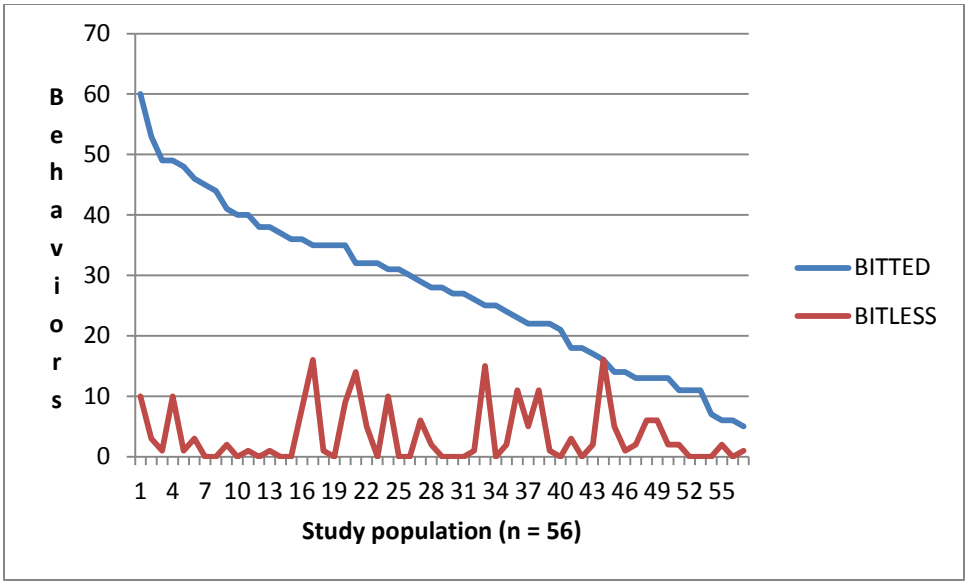

Figure 2. Case data sorted in descending number of unwanted behaviors when bitted. 60 to 5 unwanted behaviors when bitted (blue line) contrasts with 16 to zero behaviors when bitless (red line)

Only one horse (at 44) showed the same number of signs when bitless as when bitted

	total number of unwanted behaviors in the study population	**range of unwanted behaviors**	**median number of unwanted behaviors**
BITTED	1643	5-60	32
BITLESS	202	0-16	2

Table V: Unwanted behavior data for the study population

When bitless, the reduction in the number of unwanted behaviors in the population as a whole from 1643 to 202 represented an 88% improvement (Table V and Figs.2 & 3). The median, raw bit-pain score was 30 (32 minus 2) with a range from 50 to zero. More accurately, this was expressed as 'not less than 30' as those horses for which the second column had been completed before a month had passed may have shown more improvement, given time.

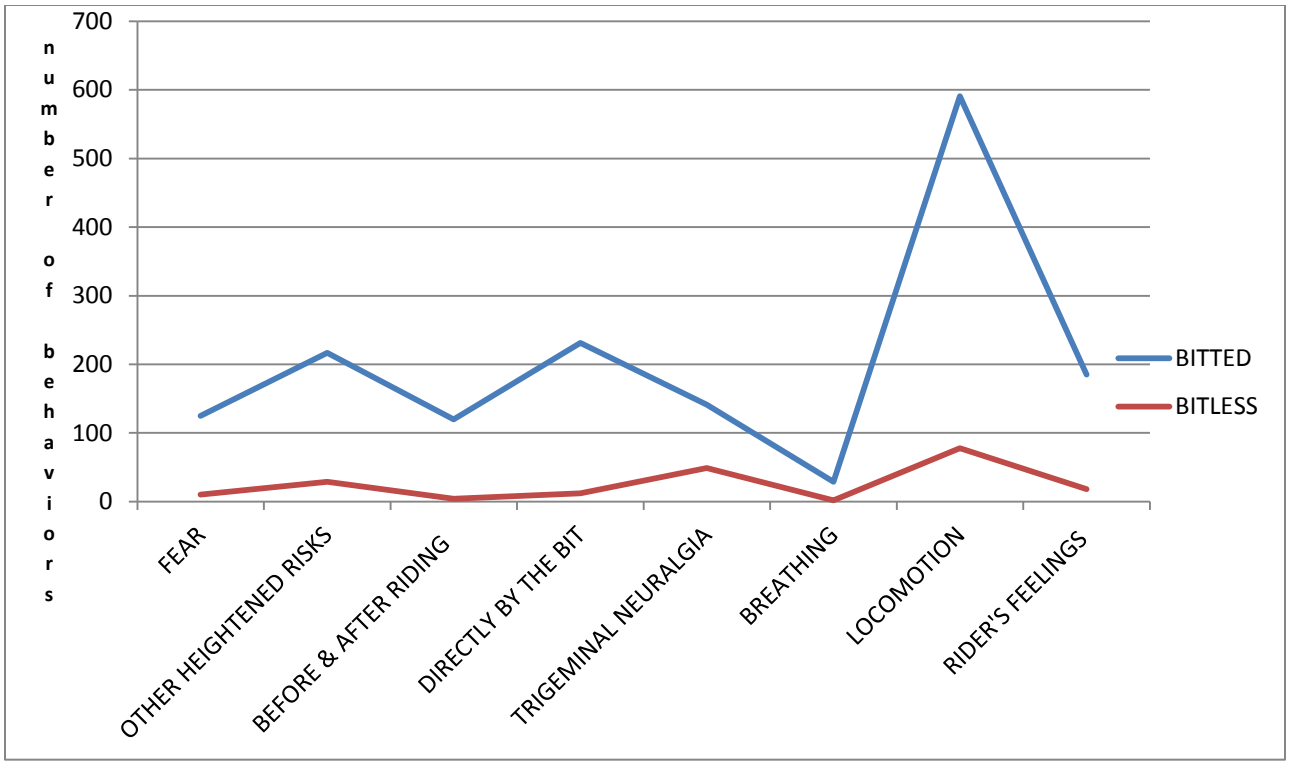

Figure 3: Number of unwanted behaviors by category when bitted (blue line) and when bitless (red line]

The time factor is especially relevant to the sometimes slow-to-regress pain of bit-induced trigeminal neuralgia and its associated unwanted behaviors of head tossing, muzzle rubbing and other signs. More accurately, not less than 88% of the unwanted behaviors in the study population were shown to be caused by the bit.

All of the 86 unwanted behaviors listed in Table I were found to be caused by the bit, so every question was shown to be relevant. Figure 3 shows how the bit had an especially negative effect on locomotion. This applied even without counting the category of fear (fright, flight, fight and freeze) for which locomotion is the predominant feature. It also shows how the unwanted behaviors were substantially reduced in every category. Statistically, the reduction was significant as judged by a Wilcoxon W of 1770 and an estimated median difference of 22 (**p<0.001).**

Bit-Pain score:

The measure of bit pain was time dependent. Taking as an example, Case # 36a (Table VI) the raw bit pain score was 50 but it was more fully expressed as

2 year: 60 – 10 = 50 (83%)

Indicating that …

- after two years of being bitless
- unwanted behaviors were reduced from 60 to 10
- the raw bit-pain score was 50
- removal of the bit reduced the number of unwanted behaviors by 83%

The need for a time prefix for the score is illustrated by the results obtained by two riders who completed the bitless column of the questionnaire twice (Table VI).

For example, with Case #7, a 5-day raw bit-pain score for this 9-year-old Thoroughbred was 19 with only 54% of unwanted behaviors eliminated, whereas the 9 month score was 34 with 97% eliminated. Case #36 as an 8 year-old was *'dangerous'* and euthanasia was considered. After being bitless for 2 years she was reclassified as *'a challenging mount.'* After another 8 years, a long-term report stated that during this period she had become *'completely re-schooled.'*

CASE #	AGE (years) at time of review	TIME BITLESS	Number of unwanted behaviors when bitted	Number of unwanted behaviors when bitless	Raw BIT-PAIN SCORE	% REDUCTION in unwanted behaviors (improvement)
36a	10	2 years	60	10	50	83
36b	18	10 years	60	0	60	100
7a	9	5 days	35	16	19	54
7b	10	9 months	35	1	34	97

Table VI: Data for two horses that were reviewed twice.

As 55 out of 56 horses (98%) showed a marked lessening of unwanted behaviors when the bit was removed it was concluded that aversion to the bit was the norm in this population.

DISCUSSION

Questionnaire assessment:

The psychometric approach requires that measuring 'instruments' (i.e., structured questionnaires) demonstrate the properties of validity, reliability, responsiveness, practicality and ease of interpretation (Reid et al 2013). In these respects the questionnaire was considered content-valid in that it tested for pain. Its construct validity was supported by the results, i.e., the pain scores dropped when a source of pain was removed. The questionnaire's reliability was confirmed by a correlation between pain scores and behavior changes before-and-after an equipment change. The questionnaire passed the test of responsiveness, being sensitive enough to detect health changes that were both statistically significant and important to horse and rider. It was also responsive to improvement over time in the two horses for which follow-up

questionnaires were completed. In terms of practicality, the questionnaire was correctly completed by 65% of responders. Finally, results were easy to interpret.

Nevertheless, a prototype questionnaire is an ongoing process. A second generation questionnaire could separate some of the multi-part questions. Certain line items could be weighted so that more serious welfare and safety problems were assigned a greater numeric value than others. For example, bolting, bucking, rearing and refusing a jump could be assigned a numeric value of four, rather than one.

The behavior vocabulary was chosen for ease of understanding but, in future more objectivity could be introduced and functional inferences avoided. Further editing could reduce some overlapping.

Instead of a simple 'yes/no' response to each line item, the 'yes' answers could be split into 'mild, moderate and severe.' This would enable data to be gathered on the initial severity of pain when bitted and shades of change when bitless.

Study population selection

A possible bias in the selection of the study population needs to be considered as a potential weakness of the study. If those riders who completed the questionnaire comprised a group of owners who were already aware that their particular horse was especially bothered by the bit, this would be reflected in a greater than average improvement in behavior when the bit was removed.

The results from a similar and independent series of experiments carried out on a 'closer-to-random' population tend to refute this possibility. In 2007, the CEO of a riding center with 27 horses made the decision to switch all her horses from bit to bitless and monitor the results using the same questionnaire (Carey 2007). Two non-riding coaches made the assessments over a period of 8 months as each horse (with different riders) was transitioned. 77% of the collective unwanted behaviors were eliminated. Recognizing that the assessments could not be as searching as those carried out by the rider, this figure is in line with the 88% elimination of the present study.

Similarly, from an internet survey of horse owners, Hockenhull and Creighton (2013) reported that 91% of 1,326 horses in the United Kingdom (predominantly bitted, leisure riding horses) exhibited many of 15 pre-selected behavior problems under saddle (column 1, Table VII).

BEHAVIOR	Hockenhull & Creighton %	Bitted %	Bitless %	Improvement %
shy	50	50	3	93
Move off before asked when rider mounts	46	22	2	89
Pull/lean on the bit	45	40	5	88
Jog when asked to walk	32	19	1	94
Trip over its own feet	29	20	7	66
Buck	17	15	2	84
Rear	7	12	3	70

Table VII: Showing, in the first two columns, a rough correspondence between the prevalence of comparable line items in descending order from the survey by Hockenhull and Creighton (2013) with the same line items when bitted from the present study. The last two columns show the percentage changes when bitless in the present study For a complete record of the line item improvements in the present study, see Table I.

In conclusion, the author is of the opinion that the study population of 56 horses was reasonably representative of ridden horses in general.

Differentiation between inherent and acquired characteristics

Questionnaire responders discovered that their horse showed many more signs of bit-induced pain than they expected. Regrettable character and temperament traits that riders assumed to be inherent were among those to be eliminated. Many of the eliminated signs were those associated with accidents.

The lesson learned from this is relevant to those riders who, without having tried a bitless bridle, maintain that their horse accepts the bit happily and shows no signs of pain. A rider who believes that her bitted horse is not exhibiting pain is probably failing to recognize the signs. Unless a rider first removes the bit and gives her horse the opportunity to show to an impartial judge that no improvement occurs in behavior, performance and rider/horse harmony, such a belief lacks credibility.

The non-disclosure-of-pain policy that the horse is credited with does not apparently apply to bit-induced pain. A horse that failed to react negatively to oral pain would be a most unusual horse.

Differentiation between acute and chronic bit-pain

In human medicine, one definition of chronic pain is - any pain that last longer than 12 weeks. In this sense, all 56 horses exhibited chronic pain. Another definition is - any pain for which a cause is not apparent. In this sense, one horse would be so classified, as there was no conclusive evidence of bit-pain at the time of an early evaluation (less than one month in a 13 year-old Quarter Horse head tosser).

For the horse, bit-pain can also be defined as acute (pain in the presence of the bit) and chronic (bit-pain that persists in the absence of the bit). In relation to the sign of head tossing, for example, such pain might be classified as either acute or, as in suspected trigeminal neuralgia, chronic. Horses showing clinical signs consistent with trigeminal neuralgia can be expected to require longer recovery periods.

Similarly, unless sufficient time has passed after bit removal, some horses may still exhibit the behavioral signs of fear, the retained memory of pain. As pain has been defined for the purpose of this article as inclusive of distress, such a sign still counts as pain. It follows that to distinguish between acute and chronic pain in this sense would require, say, a 2-day bitless questionnaire to be compared with a 2-year questionnaire or longer (see Table VI, Case #36).

The questionnaire as an aid to diagnosis

Completion of column one of the questionnaire provides a behavioral profile (ethogram) on a ridden horse and can be used as an aid to diagnosis. The ethogram on a bitted horse could, in the first instance, be used simply to document a horse's history. This might enable a veterinarian to obtain a better understanding of the many behavioral problems that prompt owners to seek advice.

Removal of the bit as an aid to diagnosis.

Three examples illustrate this feature. First, elective removal of the bit can be used in the differential diagnosis of abnormal respiratory noise at exercise, to distinguish between bit-induced nasopharyngeal asphyxia (palatal instability and dorsal displacement of the soft palate) and recurrent laryngeal neuropathy (Cook 2013, 2014). Secondly, as a definitive diagnosis of equine protozoal myeloencephalitis is difficult and its clinical signs are the same as many caused by bit-pain, removal of the bit will differentiate the two. Thirdly, in the differentiation of behavioral problems that could be caused by the bit or the saddle, removal of the bit offers a more effective and economic way of distinguishing the two than replacing the saddle.

A contribution to evidence-based medicine

Tables I and VII, show the percentage improvement in 56 horses following bit removal for 86 behavioral problems. More such evidence-based data is needed.

Update of competition rules for ethical equitation

Data is required to persuade the stewards of horse sports and racing jurisdictions to address the negative effect of the bit on the welfare and safety of horse and rider. In disciplines for which bits are currently mandated, a 'Catch 22 ' situation applies in that the evidence in support of removing the bit is difficult to collect under competition conditions. The benefits of bit removal in racing, for example, cannot be tested under racing conditions until the rules are changed. But data could be collected during training &/or comparative data from other disciplines could be used as evidence. Data from endurance racing, for example, has relevance to flat racing and evidence from show jumping to steeplechasing.

In dressage, the Royal Dutch Equestrian Federation has given the dressage world a lead in ruling, as from 1st April 2014, that level 1 & 2 competitors have the option of riding bitless. This will allow comparative data to be collected under competition conditions.

McLean and McGreevy (2010) opined that *"the future of horse sports should involve abandoning the use of primitive control devices, such as curb bits, that have real potential for causing harm. International governing bodies and national equestrian federations ought to proceed with removing any requirements to use curb bits and judges should reward riders who use the most humane control devices at the higher levels of competition."*

Development of an oral pain scale

In a review of methods available for assessing equine welfare, Hockenhull and Whay (2014) refer to pain measurements already in use and others in preparation. As the horse's mouth is such an exquisitely sensitive region and the bit such a common and potent source of pain, the present author recommends the development of an oral pain scale for adoption and independent validation.

CONCLUSION

The study showed that, in this population, the bit was a common cause of pain. All 56 horses failed to 'accept' the bit. It denied these horses, in some cases for decades, at least four of the five freedoms.

In this study, the unwanted behaviors were classified in 7 horse-based categories. But, interestingly, all 72 behaviors also fit comfortably into a 3-category system proposed for stereotypic behaviors (Fraser 1992). The definition of stereotypies is imprecise but Fraser divided them into body-based, oral-based, and reactive anomalies. Using his criteria, I have marked, in Table I, how each line item would be classified on his system. It transpires that all the unwanted behaviors can logically fit into just two categories, i.e., oral-based (29 behaviors) and reactive (43 behaviors) with a probable temporal progression from oral to reactive. Most of the reactive behaviors are hyper- rather hypo-reactive. Head tossing was placed by Fraser in the body-based category but the data from the present population indicates that it fits well in the oral-based category. As not less than 72 unwanted behaviors in the ridden horse are stereotypies correctable by removing the bit, this may throw new light on the possible cause of other oral-based behaviors such as crib-biting and wind-sucking.

A bit invades a body cavity and triggers an internal source of pain In addition to causing not less than 72 behavioral signs of pain, the bit has also been indicted for causing over 40 diseases (Cook 2007b) and many accidents, some of which are fatal to horse and rider (Cook 2013, 2014).

In an editorial, Campbell (2013) provided guidelines for distinguishing between use and abuse of animals. Campbell recommended that to avoid a charge of abuse, risk should be minimized and avoidable suffering prevented. A necessary precursor to the reduction of risk is the identification of the cause of risk. Also, to prevent avoidable suffering, methods have to be developed and implemented. Judging by the current survey, the bit appears to have been a major cause of risk in this population. Measurement of bit-pain and the introduction of an alternative to the bit responds to both of Campbell's guidelines. The infliction of bit-pain is avoidable. I hope that others will follow-up on this line of research. A standardized psychometric questionnaire on the topic is needed to further develop evidence-based data.

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DECLARATION OF INTEREST

Dr. Cook is Chairman of BitlessBridle Inc.