

Reporting authors

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Background

The horse-human relationship

Managing horses requires an understanding of their behavioural and physical needs, which are thought not to have fundamentally changed since their domestication around 6000 years ago (Budiansky, 1997). Historically horses have been used in agriculture, the military and as a means of transport but today, in the Western world, they are mainly used for recreational purposes and equestrian sports (Visser, 2002). The Swedish horse population consists of around 362 700 horses (Statistiska Centralbyrån, 2011) and the number of horses used for recreational purposes is increasing (Manimalis, 2009; Statistiska Centralbyrån, 2011). Horse owners have a varied level of knowledge, education, experience and understanding of horses' needs, which affects their choice of husbandry and management practises. This may lead to horses' needs not being taken into full consideration, thereby compromising their welfare (Mills & Clarke, 2007; Visser & Van Wijk-Jansen, 2012; Hemsworth *et al.*, 2015). Therefore, it is important to use horse welfare assessment to monitor welfare, provide feedback from such assessments and work towards improving welfare wherever possible.

Welfare is a multi-dimensional concept which comprises physical and mental aspects such as comfort, absence of hunger, thirst, disease and fear, ability to express motivated natural behaviours and a good human-animal relationship. Existing strategies to improve animal welfare (Figure 1) are often aimed at animals in the food producing industry and include welfare assessments and methods to increase consumer awareness. One example of such a strategy is the Welfare Quality[®] (WQ[®]) project, which was funded by the European Commission. To quantify welfare, adequate measures are needed in the assessment protocol. A number of assessment protocols for different species, aiming to cover all aspects of animal welfare, were developed within that project (Welfare Quality[®], 2009a; Welfare Quality[®], 2009b; Welfare Quality[®], 2009c) and after its termination a protocol for horses was developed in line with the WQ[®] approach (Wageningen UR, 2012). This horse welfare protocol was used as a basis for developing the Horse Welfare Assessment Protocol used in this study (Viksten *et al.*, 2017).

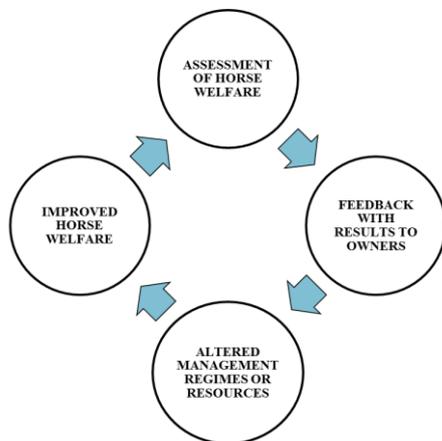


Figure 1. Model of a systematic horse welfare assessment and improvement system.

Feedback and improvement

Previous studies have shown that horse owners differ in the way they gather information about horse welfare, which knowledge of welfare they have and whether or not they actually implement that knowledge (Visser & Van Wijk-Jansen, 2012). Factors such as attitude, motivation, previous experience and social contexts also affect the horse owners' intentions and behaviour which in turn affects horse welfare (Hemsworth *et al.*, 2015). This can be described using the theory of planned behaviour (Figure 2). The theory is used to explain human behaviour which is affected by an individual's intention to perform the behaviour, i.e. motivational factors (Ajzen, 1985; 1991). This is in turn dependent on a person's attitude towards the behaviour, which is influenced by previous experiences. Intention is also influenced by subjective norms, e.g. social pressure to perform the behaviour, and also by perceived behavioural control, e.g. the person's confidence that he or she can perform the behaviour (Ajzen, 1985).

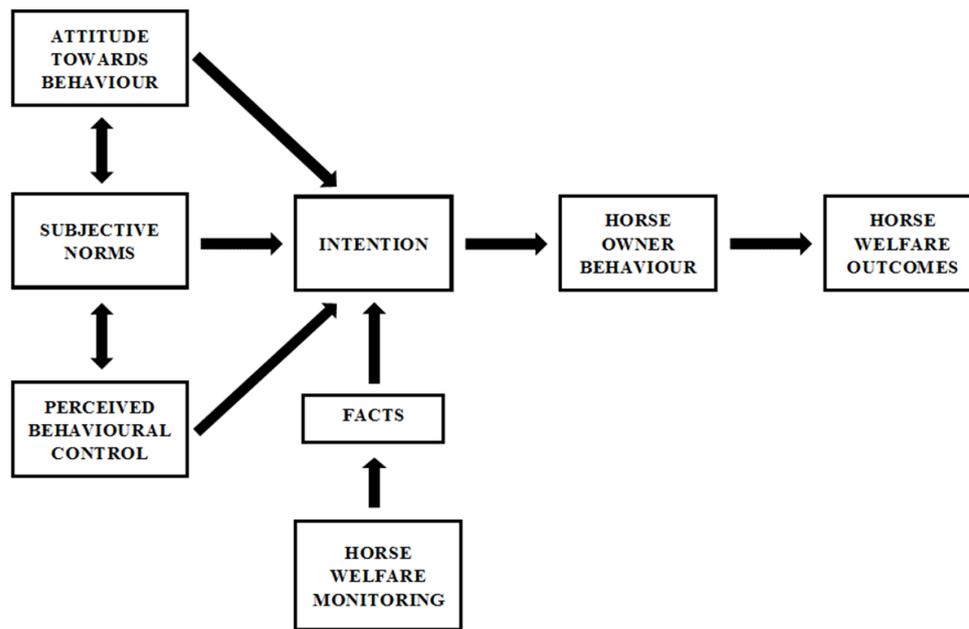


Figure 2. Theory of planned behaviour, adapted from Ajzen (1985) and Hemsworth *et al.* (2015) (Viksten, 2016).

In order for someone to accept feedback from welfare assessments and use it to implement actual changes, studies have shown that the receiver of the information needs to believe in the results and in the assessment (Jansen *et al.*, 2010). This belief and perceived behavioural control depends on a number of factors and animal owners and farmers are of course also part of a wider social context that needs to be taken into consideration (Ajzen, 1985; Jansen *et al.*, 2010; Visser & Van Wijk-Jansen, 2012). By raising awareness of how horse owners' behaviour is causing welfare issues there is an opportunity to change their attitude, subjective norms and thereby their behaviour. To establish this sort of self-insight through facts from horse welfare assessments may be challenging, not least since the owners are generally not intentionally causing welfare issues.

Although several protocols for assessing horse welfare have been developed, international standardisation is lacking and legislation varies even between neighbouring countries. There are official controls of animal welfare in some countries; however, official protocols sometimes lack sufficient animal based measures to fully assess the horses' actual welfare status. There is also a lack of feedback systems that aim to implement scientifically based advice in order to improve actual horse welfare.

The general aim of the study that is reported here was to contribute towards the development of a systematic horse welfare assessment and feedback system. The developed system was tested under Swedish conditions. Emphasis was put on developing a feasible system with the potential to be applied in systematic horse welfare assessments in Sweden and potentially internationally.

The more specific aims of the study were:

- To investigate motivational factors behind horse owners' decision making in horse welfare and what they consider relevant aspects of feedback from welfare assessments.
- To evaluate how feedback from welfare assessments provided to horse owners affect actual horse welfare.

Materials and methods

All studies were approved by the Uppsala Ethical Committee, permit no C145/11 and C319/11.

Study I

The aim of Study I was to use a questionnaire to investigate the motivational factors behind horse owners' decision making on horse welfare, to find out where they gather information on horse welfare and to ask them how they would like to receive feedback from horse welfare assessments.

A Swedish questionnaire with 17 questions (see Table 15 in Viksten, 2016) was distributed online to horse owners (owning or being responsible for one or more horses). The questions, most of which were multiple choice with more than one response possible, concerned experience in horse management, information sources, motivational factors for decision making and preferences regarding feedback of results from a systematic horse

welfare assessment. The owners accessed the questionnaire via the websites Hippson (www.hippson.se), Hästsverige (www.hastsverige.se) and social media such as Facebook and Twitter. The questionnaire was designed and completed in Netigate (www.netigate.com) whose software was also used to compile results into tables and figures displaying the percentage response rates for each question (sometimes several responses possible for one question). All answers were presented along with the number of respondents for each question.

The database

According to results from the questionnaires in Study I and questionnaires sent to participating stables in Study II, there was a need to compare results and see them in a clearer way than in the computer files provided in the feedback. Therefore a database was created where horse owners will be able to log on and see the results from horse welfare assessments presented on individual and group level. Results can also be displayed in tables and are provided with explanations of the measure used. The results can be compared to golden standards and results of other stables (all anonymous to each other). The beta-version of the database can be accessed at www.horsewelfare.se, for more information please contact Sofie M. Viksten.

Study II

The aim of Study II was to determine whether two different types of feedback had any effect on actual horse welfare by assessing and re-assessing a group of stables.

Twenty-one stables were used (three livery yards and 18 riding schools) with a total of 365 horses (ages 5-6 years; 251 geldings, 110 mares, 4 stallions) from various housing conditions (22 horses kept in group loose housing, 283 single box, 60 single tie-up stall). Stable managers had varying educational backgrounds and experience. The stables had been assessed previously in another study (Viksten *et al.* 2016) and were re-assessed here using the same HWAP protocol. The stables were divided into two groups by first pairing up those of approximately the same type (e.g. riding school) and number of horses. The stables in each pair were then allocated randomly to one of two groups of 11 and 10 stables, respectively. Stable managers in the respective groups were provided with the assessment outcomes and one of two types of feedback within a month of assessment. The high feedback group (HF) received the results plus specific information and support regarding the outcomes, background information on the assessment measures and details of possible improvements whereas the low feedback group (LF) only received the assessment results (Table 1).

Group	HF (10 stables)	LF (11 stables)
Content of feedback	Microsoft Office Excel sheet (computer file and a paper copy) - results of individual horses - stable average for each measure - benchmark HWAP scoring sheets Support telephone calls Examples of specific solutions in "worse" areas	Microsoft Office Excel sheet (computer file and a paper copy) - results of individual horses

Table 1. *The content of the feedback that the two groups received after the first assessment.*

The second assessment was conducted in the same way as the first. Horses that were assessed in only one of the two assessments, and measures where no welfare problems were observed during either assessment, were excluded from analysis. Similarly, measures such as housing or paddock size, ceiling height etc. were excluded since such resources did not change between assessments. The stable managers' formal education was divided into three categories: none, basic and advanced. Basic included: single courses on horse management (e.g. on feeding regimes), basic level courses for riding instructors (e.g. from the Swedish Equestrian Federation or Icelandic Horse Federation), and trainer education (level A-C or equivalent). Advanced level included university level education (BSc or MSc) in animal husbandry or other subjects associated with horse management.

Data management and statistics

All assessment results (scores) were converted so that the scoring system for all measures used a 0-2 scale where 0 meant least negative impact on welfare (closest to ideal state) and 2 meant the most severe impact on welfare (farthest from ideal state). This meant that results from measures originally scored 0 or 1 were altered so that 0 remained 0 and score 1 was altered to 2. This was done to harmonize the scoring to a binary system of 0-2. The measure BCS, which was originally on a five point scale with half-points in between (Carroll & Huntington, 1988; Wright *et al.*, 1998) was altered so that 3 was scored as 0 (closest to ideal state), 2 and 4 were scored as 1, and 1 and 5 were scored as 2. Averages for each measure were calculated for every stable (all horses in the same

stable). The score conversion also enabled the calculation of an average overall score for each stable (all measures included). These stable overall (SO) scores were analysed using a paired t-test (for normally distributed data) and a Wilcoxon signed rank test (for non-normally distributed data) to determine if significant changes had occurred between assessments. A Ryan-Joiner test was used to determine normality of the score distribution.

The averages of those measures which detected welfare problems (measures with an average above 0; i.e. occurrence of a welfare problem in the first assessment) were summed in each stable. These stable welfare issue (SWI) scores for the first and second assessment, as well as for the HF and LF groups, were then analysed using a paired t-test and a Wilcoxon signed rank test as per above.

All analyses were run at 5 % significance level using the computer statistics package Minitab® (version 16.1.0., Minitab Ltd. UK).

Results

Study I

The online questionnaire (Table 4) was answered by 625 horse owners of which 76 % (476/625) were recreational riders and 24 % (149/625) were professionals (working full-time with horses). Both groups had between 1-55 years experience and 92 % (575/625) were responsible for less than ten horses (professionals were responsible for 1-50 horses and recreational horse owners for 1-30 horses). Main uses of the horses (several responses possible) were all-round riding (a mix of show jumping, hacking and dressage) 61 % (359/588), dressage 45 % (265/588) and show jumping for 36 % (211/588) of respondents.

The main welfare areas where horse owners previously had questions were feeding regimes (347/560 respondents; 62.0 %), housing (322/560; 57.5 %), the size of paddocks (305/560; 54.5 %) and horse health (390/479; 81.4 %). The most important factors influencing decision making relating to the horses' management and care were horse health and behavioural issues (Figure 3). The least influential motivating factor was external support (e.g. advice, financial help) for changes (e.g. from a federation).

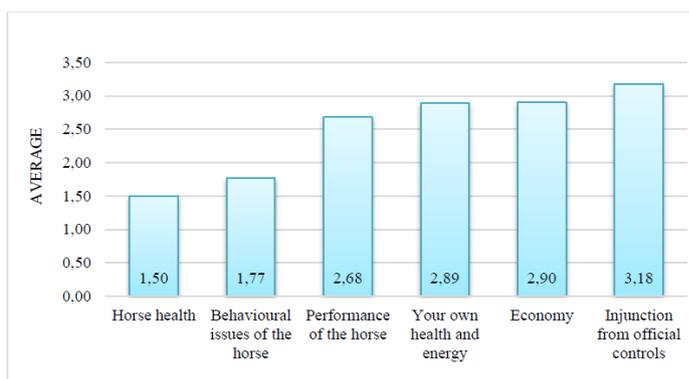


Figure 3. Motivating factors behind decision making for horse owners presented as an average of the scores each factor received in the question where factors were ranked from 1-7 (1 being the most important factor).

Sources of information that were used as a basis for alterations in management are depicted in Figure 4. Eighty seven percent (378/432) of respondents stated it was "important" or "very important" to discuss ideas with other horse owners and 91 % (394/432) were currently doing this.

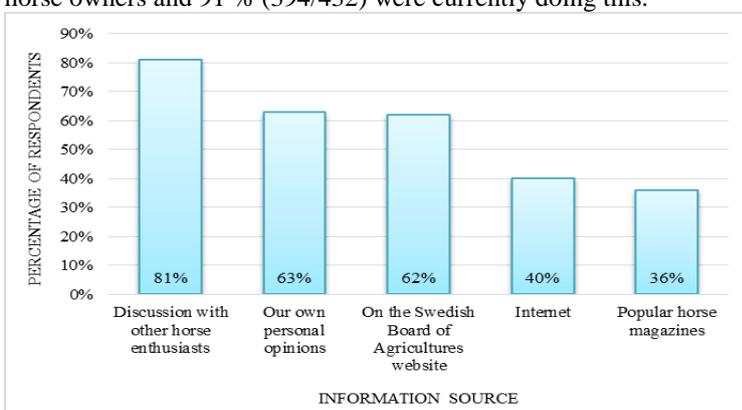


Figure 4. Information sources for support in decision making around horse management. Presented as percentage of 480 respondents (several response options possible).

When asked about the form of feedback 76 % (339/445) of horse owners indicated that they wanted the results of assessments on computer file, 97 % (436/451) said, it should contain background information on all measures used in the assessment and 77 % (344/450) wanted results for individual horses as well as on group level. Ninety one percent (406/448) of horse owners wanted a benchmark or average score so that they could compare their results to that of other horse owners, 83 % (366/439) wanted improvement suggestions specifically targeted at their stable and 47 % (206/439) wanted the feedback to contain good and bad examples as comparators. Forty three percent (186/436) of horse owners would like the assessor to revisit as part of a follow up whilst 29 % (129/436) preferred a phone call and 28 % (121/436) declined any post-assessment follow up.

Study II

Eighty four of the 449 horses used in the first assessment did not participate in the second assessment because they were no longer available (ill, dead, re-homed, sold etc.). This yielded a study total of 365 horses.

Analyses of stable overall (SO) scores showed no significant differences. On the other hand, significant differences in individual measures between assessments were found in both feedback groups; (6 in the high feedback (HF) group, 5 in the low feedback (LF) group); four of these measures coincided in both groups (see Table 17 in Viksten, 2016). The HF group showed significant improvement in water trough cleanliness, equipment chafing and number of open fresh air inlets but also significant deterioration in water drinker function, ocular discharge and the sum of RH and T. The LF group improved significantly in feeding- and water trough cleanliness and in equipment chafing but deteriorated significantly in mane and tail condition and in the sum of RH and T.

The stable welfare issue (SWI) scores were significantly improved between assessments in both the HF and the LF group. There were significant decreases between assessments in SWI median scores for both the HF (10 stables, $W = 5.0$, $P = 0.025$) and the LF (11 stables, $W = 0.0$, $P = 0.004$) groups. Eight stables improved (SWI average closer to 0) and 2 deteriorated (average further from 0) in the HF group whereas all LF stables improved.

There were also several non-significant changes in individual measures suggesting both improved and deteriorated welfare; five (50 %) stables improved and five (50 %) deteriorated in HF whilst seven (64 %) improved and four (36 %) deteriorated in LF. For some measures more SO scores improved than deteriorated (e.g. water cleanliness, mouth health and equipment chafing): 17 (60.7 %) in the HF group and 16 (57 %) in the LF group. However, for other measures (e.g. BCS and ocular discharge) more stables deteriorated than improved; 10 (35.7 %) in HF and 9 (32 %) in LF, respectively.

Discussion

Attitude: assessing horse welfare

An individual's positive or negative evaluation of performing a certain behaviour can be referred to as their attitude towards the behaviour (Ajzen, 1985). A horse owner's behaviour and choice of managerial regime is crucial to determining the horses' welfare status. The education and knowledge level of a horse owner does not guarantee that implementation of the knowledge occurs, thereby ensuring a high level of welfare (Visser & Van Wijk-Jansen, 2012; Viksten *et al.*, submitted-b). Hence, horse owners might know better than their current behaviour and managerial regimes show, but they might not alter their behaviour to increase welfare. The theory of planned behaviour can be used to put horse welfare assessments and horse owners' behaviour into a wider context, as previously discussed by Hemsworth (2012; 2015).

Influencing owners' behaviour via horse welfare assessment

When developing and applying a protocol for assessment of horse welfare the aim is to assess the actual welfare status in a feasible, valid and repeatable manner. The protocol also indirectly measures the horse owner's behaviour and managerial regimes since this is reflected in the actual welfare status of the horses (Hemsworth *et al.*, 2015; Viksten *et al.*, submitted-b). If an assessment is followed by feedback of results it has the potential to clarify the aims (improving horse welfare), change the attitude and positively influence the horse owner's behaviour. However, a number of requirements need to be fulfilled for this to happen. Assessing and supplying feedback needs to be conducted in a transparent way that increases horse owners' and "consumers" (e.g. riders at riding schools) knowledge and awareness of welfare (Blokhuys *et al.*, 2013). The results in this study strongly suggest this requires an assessment of each individual horse using a mix of measures and an interview with the horse owner (or where applicable: the stable manager) to gather information on managerial and husbandry regimes and other required information about the horses and their housing.

The choice of measures and their relevance to welfare must be easily understood by horse owners in order for them to trust the results. Measures also need to be feasible, repeatable and scientifically validated. The results from previous studies (Viksten *et al.* 2017) show that 66 % (31 out of 47) of the measures incorporated in the assessment protocol had over 85 % repeatability (conducted by one assessor) and that the assessment can be conducted in a way acceptable to horse owners and managers. The study also shows that although measures are

validated and reliable (e.g. BCS from Carroll and Huntington (1988)) repeatability might be low due to a real change in conditions. Therefore, measures with lower repeatability are still considered relevant, but must be placed in the wider context of other potentially influential variables (e.g. season, use of the horse, feeding regime) and thereby require regular monitoring. The benefits of regular monitoring and using scientifically sound measures need to be further explained to horse owners. By explaining and ensuring an understanding of the assessments and underlying reasons for monitoring welfare, attitudes can most probably be affected to facilitate behaviour towards improved horse welfare.

Intentions and subjective norms: what do horse owners want?

An individual's intention to perform certain behaviours can be described as the motivational factors that influence a behaviour (Ajzen, 1985; Ajzen, 1991). The intentions may change over time and are influenced by experiences and subjective norms, e.g. social pressure to perform the behaviour (Ajzen, 1985).

In order to explore horse owners' intentions and subjective norms Study I included a questionnaire and the results yielded useful information on the decision making of horse owners concerning horse welfare. The respondents clearly considered horse health and behaviour as the two most important motivational factors influencing their decision making on management and welfare. Factors like the respondents' own health, the economy and official injunctions were considered less important. This suggests that many horse owners regard their horses as individuals with an intrinsic value and not just with an instrumental value for a specific purpose or for making a profit. External support from various bodies, e.g. federations, was considered the least important factor underpinning the decision-making process. Support from federations is probably more important for professional stables and riding schools (who are usually members) in order to ensure a high quality level of service for customers, to be allowed to arrange competitions, for insurance purposes and to gain access to advisory services (Svenska Ridsportförbundet, 2016).

Although non-compliance with legislation discovered during official controls may lead to fines for the horse owners, such injunctions were not regarded as particularly important by horse owners. This might be due to the fact that most respondents in the questionnaire do not need official permits to run a stable which is a requirement for professional stables and stables with more than 10 horses (Djurskyddslagen, SFS 1988:534). Inspections at stables that do not require permits would only be conducted if there were complaints. This may well explain the owners' views on non-compliance. It may also reflect a lack of well-founded information about welfare legislation and its potential benefits.

Study I shows that exchange of information and experiences with other horse owners and horse enthusiasts is the most common way of gathering knowledge. This practise runs the risk that scientific evidence is ignored and that the use of misleading information and related risk factors may be increased (Leckie, 2001).

Horse owners' behaviour is known to affect horse welfare (Hemsworth *et al.*, 2015) and owners often differ in regards to welfare improvement, information gathering, attitude and knowledge levels (Visser & Van Wijk-Jansen, 2012). Even though scientifically based feedback from welfare assessments can be adapted to match owners' preferences, there is no guarantee that this will result in positive changes in management and improved horse welfare.

The social culture in stables and clusters of owners is probably very influential with regard to how scientific and valid the information is that is exchanged between horse owners. Studies have also shown that visiting professionals such as veterinarians might influence the knowledge levels in horse owners (Visser & Van Wijk-Jansen, 2012). This may cause large local variances in absence or presence of welfare issues depending on the local professionals.

Subjective norms can be changed and self-taught horse owners can be educated through courses (e.g. stable schools led by a researcher or teacher) and feedback from welfare assessments. This approach has been tested on animal owners within the farm-industry with successful outcomes (Vaarst *et al.*, 2007). There is clearly great potential for effective knowledge transfer and a clearly communicated emphasis on the benefits of welfare improvement for the horses and their owners (Main *et al.*, 2014). The feedback needs to be accessible, correct, understandable and concise so that all owners, regardless of their level of background knowledge and education, can understand welfare concerns and take appropriate informed decisions (Leckie, 2001). The most challenging aspect will be to reach out to recreational horse owners and to realise effective implementation of the feedback and the related welfare improvements.

Intentions and perceived behavioural control: do horse owners see improvements?

An individual's previous performance affects his or her perceived ease or difficulty of performing a particular behaviour. This is referred to as perceived behavioural control and affects if an individual is likely to perform a certain behaviour (Ajzen, 1985).

Official welfare assessments

The Swedish official system for horse welfare assessments uses mainly resource based measures, provides quite little feedback and gives hardly any advice to horse owners. This may affect the perceived behavioural control of owners, which in turn affects their intentions. The risk is of course that an assessment that the horse owner does not understand or accepts hampers changes in behaviour (e.g. management regimes) that could have improved horse welfare. If the feedback was instead complimented by personalised advice, education of horse owners (e.g. through stable schools) and self-assessment schemes, meaningful improvements would be more likely.

Does feedback have an effect?

The findings in Study II revealed some significant improvements between assessments in SWI scores regardless of the type of feedback the stable received. Changes in both groups suggest that the assessment, regardless of feedback, might have worked to raise awareness and generate welfare improvements. This finding is in line with those from other research areas such as health care and psychology (Ajzen, 1985; Jansen *et al.*, 2010), where it was also found that there might be an effect independent of the feedback. Collectively those studies suggested that many other factors can affect implementation of advice and behavioural change regardless of the amount of support and information given. A system that aims to increase welfare will very likely require the provision of feedback capable of addressing the characteristics and requirements of individual animal owners rather than just supplying general information aimed at all animal owners (Jansen *et al.*, 2010; Visser & Van Wijk-Jansen, 2012).

The significant improvements observed in both feedback groups in Study II involved features that could easily be improved without large financial investment or large structural and managerial changes, e.g. better trough cleanliness and opening more (existing) air inlets. The routines used for trough cleaning are easily altered and our results suggest that the stable managers became aware of the issues after the first assessment and took steps to improve the welfare of their horses. Clearly, non-managerial changes can occur between assessments which are independent of the type of feedback. For example, seasonal changes may have affected the welfare outcomes, as the stables were first assessed in winter and early spring, received feedback and were then re-assessed about six months later in the late autumn.

Addressing welfare issues such as insufficient ventilation systems requires necessary funds, locating and hiring a suitable contractor, applying for permits and timing the effort when horses are either moved to another facility or on summer pasture. This may explain why stables in Study II had not corrected their malfunctioning ventilation systems or paddock surfaces during the six months between assessments. Another possible reason for the lack of remedial action in some measures may have been that the managers did not believe in the results or the importance of the assessment or individual measure. However, although the education levels of staff were associated with the occurrence of injuries and other welfare issues in previous studies (Lönnell *et al.*, 2012) the findings in Study II suggest that the managers' education and experience were not related to the implementation of improvements arising from the feedback, or the improvement of welfare scores.

The feedback provided in Study II was not particularly successful in altering behaviour of the stable managers, despite voluntary participation and perceived high motivation levels. The reason behind the inconclusive results might simply be that six months was an insufficient time period to see significant changes, but may also indicate more complex underlying issues. It is also recognised that explaining the complexity of how different welfare measures correlate to one another is difficult and that alternative ways of delivering feedback might be a solution, e.g. through meetings, lectures and stable schools. The results of Study II highlight that many factors affect the implementation of knowledge. The results revealed hidden welfare issues even in these "nice" stables which may indicate a lack of knowledge in stable managers and horse owners about how to assess and improve horse welfare on an everyday basis.

The participating stables supplied very useful response on the assessments and information that they received in the study. Their responses also revealed attitudes towards horse welfare that were quite concerning. These included a reluctance to trust in published research, denial of existing welfare issues, putting performance of horses above welfare and a lack of interest in even looking at results from assessments (Viksten *et al.* unpublished results). This highlights the need for a clear, concise feedback system and support to horse owners so that they will change their attitude and behaviour and be more open to constructive criticism.

Concluding remarks

The results from the studies indicate that there are welfare issues even in stables with experienced and well-educated personnel. The assessment protocol, HWAP, discovered these issues and shows potential as a feasible welfare assessment tool in systematic horse welfare assessments. When inquiring into what horse owners want from welfare assessments in Study I, the need for knowledge and possibly advisory services in horse welfare became clear. Many owners wanted feedback to enable comparison to results of other stables, a type of benchmarking, which is facilitated when a stable is awarded an overall welfare score with different ratings (see the WQ[®] approach (Veissier *et al.*, 2011)). This sort of benchmarking would open possibilities for stables to market themselves regarding horse welfare which encourages good horse welfare and may lead to increased

business opportunities. Considering the results from the studies, one conclusion is that there might be a need for systematic horse welfare monitoring in Sweden, apart from the existing official controls. This system would need to include a holistic approach with several important parts: assessment using a mix of valid, repeatable and feasible measures, interpretation of results, providing horse owners with feedback and possibly a certification system.

Successful implementation of evidence-based research outcomes in human healthcare routines (Rycroft-Malone & Bucknall, 2010; Seers *et al.*, 2012) and in quality assurance programmes in the livestock industry (Edge & Barnett, 2009) suggest that strategies such as stable schools, educational programmes, dissemination of best practices for management etc. could be applicable to the horse industry. Furthermore, provision of feedback with suggested changes and information on welfare should be tailored to the personality type of the person receiving feedback in order to improve managerial regimes (Jansen *et al.*, 2010). Factors such as their trust in external information, attitude towards the outside world, the social context and their ethical viewpoint on animal welfare (Heleski & Anthony, 2012) also affect how animal owners perceive the information (Jansen *et al.*, 2010). Therefore, implementation strategies need to cater for different kinds of horse owners (and stable managers) (Visser & Van Wijk-Jansen, 2012). Motivational factors must also be identified (Viksten *et al.*, submitted-a) because they are unlikely to be identical to those in the food-animal production sector where for instance pressure from interest groups and consumer awareness are more obvious (Blokhuis *et al.*, 2010b).

The studies in this thesis indicate that there are many variables around measures and how they interact with each other that need to be accounted for in interpretations of results. This is a challenge when formulating feedback to horse owners and might require new ways of delivering feedback as discussed in Study II. Another possible difficulty in the interpretation of results is that horses are often individually managed although they reside in the same housing. This requires assessment of all individual horses, as concluded in Study II, which is more time consuming and may hamper stable-level feedback. Individual management is possibly unique to horses and might not occur in other farm animals assessed with protocols developed in the WQ[®] system.

Publications

- Viksten, S., Blokhuis, H.J., Nyman, S. and Visser, E.K. (2012) Developing a protocol for welfare assessment in horses. In: H. Randle, N. Waran and J. Williams (Eds), Conference Proceedings 8th International Equitation Science Conference, Royal (Dick) Veterinary School, Edinburgh, 18th - 20th July 2012. Edinburgh, p 136.
- Viksten, Sofie M. and Blokhuis, Harry J., 2016. Improving Horse Welfare through Assessment and Feedback. Welfare Quality Network Seminar, 24 November 2016, Helsinki, 17.
- Viksten, S.M. (2016). Improving horse welfare through assessment and feedback. Doctoral thesis. Uppsala : Sveriges lantbruksuniv., Acta Universitatis agriculturae Sueciae, 1652-6880 ; 2016:68, ISBN 978-91-576-8638-1.<http://pub.epsilon.slu.se/13566/>
- Viksten, S.M., Visser, E.K., Nyman, S. and Blokhuis, H.J., 2017. Developing a horse welfare assessment protocol. *Animal Welfare* 26, 59-65.
- Viksten, S.M., Visser, E.K. & Blokhuis, H.J. Swedish horse owners' decision making on welfare: motivational factors and information needs. (Submitted).
- Viksten, S.M., Visser, E.K., Hitchens, P.L. & Blokhuis, H.J. The effects of feedback from horse welfare assessments. (Submitted).

Dissemination of results to agricultural sector

Sofie Viksten has participated in a reference group at the Swedish Equestrian federation since 2013 and continues to do so. Her research has been used in the published tool for building horse-facilities <http://www.emagin.se/paper/t4vd20b8/paper/#/paper/t4vd20b8>.

Sofie Viksten has been involved in the development of the horse welfare programme "Travanhälsan" at the Swedish Trotting Association and will work on its further development during 2017.

The results from the study has been published on the popularscientific website www.hastsverige.se, www.hippson.se, www.bukefalos.com, www.travsport.se, www.thehorse.com and in popularscientific magazines such as Tidningen Ridsport, Veterinärmagazinet, Hippson etc.

Sofie Viksten continues to spread the results through lectures and talks on horse welfare in collaboration with the Swedish Equestrian Federation and through her own company Ecosof Hästfokus, lectures have been held countrywide and will be held at the European Championships in Gothenburg 2017 and at Boden Business Day 2017 to mention a few.

Limitations of the studies

The stables were participating voluntarily and it is possible that only those stables agreed to be involved that were realising a high level of welfare, which might be a selection bias. Having high standards in regard to welfare may result in skewed outcomes.

The availability of only one assessor excluded testing for inter-observer repeatability in the studies and is a potential source of error in regards to the assessor possibly remembering previous results from assessments. This risk was however reduced by blinding the assessor to previous results (not accessing them or analysing them) between assessments.

In order to evaluate if the HWAP is valid for monitoring changes over long periods, a longer study is required with several repeated assessments.

Not all horses present at the stables were used in all measures or even in both assessments in Study II since some were excluded due to illness, being away at training, being sold (not present at stable anymore) or euthanized between assessments due to injuries unrelated to the study. This reflects the challenges with doing repeated assessments in the field: the sample population is rarely constant.

It is recognised that the questionnaire in Study I was accessed online on a free choice basis so there could have been an under- or over-representation of specific types of respondents. For example, it may have mainly attracted those horse owners specifically interested in horse welfare.

The relatively small sample size in Study I means that results might not be representative of all horse owners in Sweden.

References

- Ajzen, I. (1985). From intentions to actions: A theory of planned behavior: Springer.
- Ajzen, I. (1991). The theory of planned behavior. *Organizational behavior and human decision processes*, 50(2), pp. 179-211.
- Blokhuis, H.J., Jones, R.B., Veissier, I. & Miele, M. (2013). The Welfare Quality® vision. In: Blokhuis, H.J., Jones, R.B., Veissier, I. and Miele, M. (Eds.) (ed. Improving farm animal welfare. Science and society working together: the Welfare Quality approach. Wageningen: Wageningen Academic Publishers, pp. pp. 71-89.
- Blokhuis, H.J., Veissier, I., Miele, M. & Jones, B. (2010b). The Welfare Quality® project and beyond: Safeguarding farm animal well-being. *Acta Agriculturae Scandinavica, Section A - Animal Science*, 60(3), pp. 129 - 140.
- Budiandy S (1997) The nature of horses: Exploring equine evolution, intelligence, and behavior. The Free Press, New York
- Carroll, C.L. & Huntington, P.J. (1988). Body condition scoring and weight estimation of horses. *Equine veterinary journal*, 20(1), pp. 41-45.
- Edge, M.K. & Barnett, J.L. (2009). Development of animal welfare standards for the livestock transport industry: process, challenges, and implementation. *Journal of Veterinary Behavior: Clinical Applications and Research*, 4(5), pp. 187-192.
- Heleski, C.R. & Anthony, R. (2012). Science alone is not always enough: The importance of ethical assessment for a more comprehensive view of equine welfare. *Journal of Veterinary Behavior: Clinical Applications and Research*, 7(3), pp. 169-178.
- Hemsworth, L.M. (2012). The Welfare of Recreational Horses in Victoria: The Occurrence of and Factors Associated with Horse Welfare. Diss.: Monash University.
- Hemsworth, L.M., Jongman, E. & Coleman, G.J. (2015). Recreational horse welfare: The relationships between recreational horse owner attributes and recreational horse welfare. *Applied Animal Behaviour Science*, 165(0), pp. 1-16.
- Jansen, J., Steuten, C., Renes, R., Aarts, N. & Lam, T. (2010). Debunking the myth of the hard-to-reach farmer: effective communication on udder health. *Journal of Dairy Science*, 93(3), pp. 1296-1306.
- Leckie, E.J. (2001). Equine Population of the UK: A Report for the International League for the Protection of Horses (ILPH). United Kingdom: ILPH.
- Lönnell, C., Roepstorff, L. & Egenvall, A. (2012). Variation in equine management factors between riding schools with high vs. low insurance claims for orthopaedic injury: A field study. *The Veterinary Journal*, 193(1), pp. 109-113.
- Main, D.C.J., Mullana, S., Atkinson, C., Cooper, M., Wrathall, J.H.M. & Blokhuis, H.J. (2014). Best practice framework for animal welfare certification schemes. *Trends in Food Science & Technology*, 37, pp. 127-136.
- Manimalis (2009). Manimalisrapporten.
- Mills, D.S. & Clarke, A. (2007). Housing, Management and Welfare. In: Waran, N. (ed. The Welfare of Horses. (Animal Welfare, 1) Springer Netherlands, pp. 77-97. Available from:
- Rycroft-Malone, J. & Bucknall, T. (2010). Using theory and frameworks to facilitate the implementation of evidence into practice. *Worldviews on Evidence-Based Nursing*, 7(2), pp. 57-58.
- Seers, K., Cox, K., Crichton, N.J., Edwards, R.T., Eldh, A.C., Estabrooks, C.A., Harvey, G., Hawkes, C., Kitson, A. & Linck, P. (2012). FIRE (Facilitating Implementation of Research Evidence): a study protocol. *Implement Sci*, 7(1), p. 25.
- Statistiska Centralbyrån (2011). Hästar och anläggningar med häst 2010, korrigerad version 2011-12-05. (JO24 Hästar och anläggningar med häst. Sweden.
- Svenska Ridsportförbundet. www.ridsport.se.
- Vaarst, M., Nissen, T.B., Østergaard, S., Klaas, I.C., Bennedsgaard, T.W. & Christensen, J. (2007). Danish Stable Schools for Experiential Common Learning in Groups of Organic Dairy Farmers. *Journal of Dairy Science*, 90(5), pp. 2543-2554.
- Veissier, I., Jensen, K.K., Botrea, R. & Sandøe, P. (2011). Highlighting ethical decisions underlying the scoring of animal welfare in the Welfare Quality® scheme. *Animal Welfare*, 20(1), p. 89.
- Viksten, Sofie M. (2016). Improving horse welfare through assessment and feedback. Doctoral thesis. Uppsala : Sveriges lantbruksuniversitet, Acta Universitatis agriculturae Sueciae, 1652-6880 ; 2016:68
- Viksten, S. M., Visser, E. K., Nyman, S. & Blokhuis, H. J. (2017). Developing a horse welfare assessment protocol. *Animal Welfare*, 26(1), 59-65.
- Viksten, S.M., Visser, E.K. & Blokhuis, H.J. (2016). A comparative application of two horse welfare assessment protocols. *Acta Agriculturae Scand Section A*.

- Viksten, S.M., Visser, E.K. & Blokhuis, H.J. (submitted-a). Swedish horse owners' decision making on welfare: motivational factors and information needs.
- Viksten, S.M., Visser, E.K., Hitchens, P.L. & Blokhuis, H.J. (submitted-b). The effects of feedback from horse welfare assessments.
- Visser, E.K. (2002). Horsonality - a study on the personality of the horse. PhD thesis. University of Utrecht, the Netherlands.
- Visser, E.K. & Van Wijk-Jansen, E.E. (2012). Diversity in horse enthusiasts with respect to horse welfare: An explorative study. *Journal of Veterinary Behavior: Clinical Applications and Research*, 7(5), pp. 295-304.
- Wageningen UR (2012). Welfare Monitoring System – Assessment protocol for horses, version 2.0: Wageningen UR Livestock Research.
- Welfare Quality® (2009a). Welfare Quality® Assessment Protocol for Cattle. Lelystad, The Netherlands.
- Welfare Quality® (2009b). Welfare Quality® Assessment Protocol for Pigs Lelystad, the Netherlands.
- Welfare Quality® (2009c). Welfare Quality® Assessment Protocol for Poultry. Lelystad, The Netherlands.