A review of methods used to measure temperamental characteristics in horses

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I denna serie publiceras olika typer av studentarbeten, bl.a. examensarbeten, vanligtvis omfattande 7,5-30 hp. Studentarbeten ingår som en obligatorisk del i olika program och syftar till att under handledning ge den studerande träning i att självständigt och på ett vetenskapligt sätt lösa en uppgift. Arbetenas innehåll, resultat och slutsatser bör således bedömas mot denna bakgrund.

Innehållsförteckning

1. Sammanfattning

Hästar reagerar individuellt på utmaningar, och att ta tillvara möjligheten att använda dessa reaktioner för att med ett objektivt verktyg bedöma hästars temperament, kan ha flertalet fördelar. Det skulle kunna förbättra hästars välfärd genom att göra det möjligt att finna individer bäst lämpade för specifika användningsområden, och genom att öka kunskapen om utvecklingen av onormala beteenden som till exempel stereotypier. Skötselrutiner och träning kunde bli individanpassade och valet av individer lämpliga för avel skulle underlättas. Det finns också ekonomiska fördelar då hästköpare anser att temperament är en mycket viktig egenskap, och eftersom man efter bedömning av temperament kan spendera pengar på hästar med alla de rätta kvalitéerna. Under det senaste decenniet har man gjort många försök att mäta olika aspekter av hästars temperament, och det första syftet med detta arbete var att titta närmare på dessa studier och se vilka metoder som använts och vilka temperamentsegenskaper som mätts. Den icke-konsistenta användningen av termer, oftast utan klara definitioner, gör det svårt att jämföra studier, med beteendetester, uppskattningar ifrån observatörer, fysiologiska mätningar eller en kombination av dessa är mest använda. Fokus har riktats mot emotionalitet eller emotionell reaktivitet, reaktioner mot människor och inlärningsförmåga eller träningsbarhet. För att bedöma dessa egenskaper har olika test såsom test på öppna ytor, hanteringstest och inlärningsuppgifter utvecklats. Det andra syftet var att ta reda på vilka temperamentsegenskaper som hopp- och dressyrryttare letade efter och/eller undvek hos hästar, och om det var en skillnad mellan disciplinerna. Resultatet från en web-baserad enkät avslöjade att ryttare föredrog temperamentsegenskaperna ”*arbetsvillig*” och ”*lyssnar på ryttaren*” och undvek ”*lätt stressad och skrämd*” och ”*ovillig till arbete*”. Inga statistiskt signifikanta skillnader i preferens för särskilda egenskaper hittades mellan disciplinerna. Det sista syftet var att se om dessa egenskaper som ansågs viktiga kunde mätas med de test som redan beskrivits i litteraturen. Troligtvis skulle test utvecklade för att mäta emotionalitet eller emotionell reaktivitet kunna användas när egenskaper relaterade till reaktioner på omgivningen skall bedömas. De egenskaper som är relaterade till samarbete med människor är svårare att mäta objektivt, eftersom människan alltid kommer att påverka resultatet av testet. Det kan vara möjligt att bedöma relationen och interaktionen mellan häst och ryttare genom att använda en enkät, men terminologi med klara definitioner och beskrivningar borde utvecklas först.

2. Summary

Horses respond individually to challenges, and the possibility to use these reactions to evaluate equine temperament with an objective instrument would have several advantages. Horse welfare could be improved by making it possible to find individuals best suited for a specific use, and understanding of the development of abnormal behaviours, such as stereotypies, could be increased. Management routines and training could be adjusted to suit each individual horse and it could facilitate the selection of individuals appropriate for breeding. There are also economic implications, as horse buyers consider temperament important and after evaluating temperament, money can be spent solely on specific horses with all the right qualities. During the last decade, many attempts have been made to measure different aspects of temperament in horses, and the first aim of this project was to look at these studies and see which methods were used and which temperamental characteristics they measured. The non-consistent use of terminology, mostly without clear definitions, makes it difficult to compare studies, but behavioural tests, observer ratings, physiological measures or a combination of these are most commonly used. Focus has been directed to emotionality or emotional reactivity, reactions to humans and learning abilities or trainability. To evaluate these characteristics, tests such as open field or arena tests, handling tests and learning tasks have been developed. The second aim was to find which temperamental characteristics riders training jumping or dressage searched for, and/or avoided, in horses, and if there was a difference between the disciplines. The results from a web-based questionnaire revealed that riders preferred temperamental characteristics such as "*willing to work*" and "*listens to the rider*" and avoided "*easily stressed and frightened*" and "*unwilling to work*". No statistically significant differences in preferences for certain characteristics were found between the disciplines. The last aim was to find if those characteristics considered important by riders could be measured using tests already described in the literature, and it is suggested that tests developed for emotionality or emotional reactivity could be used when evaluating those characteristics related to reactions to the environment. Those related to cooperation with humans are more difficult to measure objectively, as the human will always influence the results of the tests. It might be possible to evaluate the relation and interaction between horse and rider using a questionnaire, but a terminology with clear definitions and descriptions should be developed first.

3. Aim of project

An increased scientific interest has rather recently been directed towards the subject of evaluating equine temperament, and a growing number of articles are being published. Scientists have looked at many different temperamental characteristics and used different methods to evaluate them, but texts that summarize or compare several authors work are scarce. There has also been limited focus on which temperamental characteristics that are considered important and relevant to measure, by riders or people working with horses. From this background, and by combining a literature review of published articles, scientific books and the results from a web-based questionnaire, this degree project tries to answer the following questions:

- Which temperamental characteristics can be measured by tests available in the literature, and which methods are applied?
- Is there a difference in preference for certain temperamental characteristics between riders training jumping or dressage?
  H01: There is no difference.
  H1: There is a difference.
- Can the temperamental characteristics considered important by riders training jumping and dressage be measured my methods described in the literature?

4. Material and Method

A review of literature was conducted through searches in the following databases for scientific publications; www.sciencedirect.com, www.isiwebofknowledge.com, www.pubmed.gov using keywords such as "horse temperament", "temperamental characteristics/traits", "horse personality", "temperament + test". Similar keywords were also used at scholar.google.se and in the search through the library catalogue LUKAS at SLU libraries. Once a relevant article was found, the possibility to do a "related article-search" was used. The aim was to use as recent literature as possible in the review, preferably published after year 2000. Nearly all references meet this criterion, with the exception of four publications that are slightly older.

A web-based questionnaire was sent out by email to 53 students pursuing undergraduate university education in equine studies at Swedish University of Agricultural Sciences. The questionnaire consisted of three questions where the participants were asked to 1) fill in which discipline (jumping, dressage or other) they were training, and also state 2) three temperamental characteristics that they searched for and 3) three temperamental characteristics they avoided in a horse intended for use in that discipline. Participation was not compulsory, but 21 persons answered the anonymous questionnaire (40% answer rate). Some stated less than six temperamental characteristics. Only the answers belonging to riders training jumping (7 respondents) and dressage (11 respondents) were used, and three answers that reflected physical characteristics (for example "slow gait action") were removed. This resulted in a total of 18 wanted and 17 unwanted characteristics for jumping horses, and 31 respectively 29 for dressage horses. The answers were evaluated and combined in seven categories that reflected different temperamental characteristics (see Table 1).

Table 1. Answers included in categories

Category	Answers included
Willing to work	Willing to work, Positive, Energetic, Wants to go forward
Listens to the rider	Listens to the rider, Attentive, Alert, Sensitive to the rider, Cooperative, Focuses on the rider
Easily stressed and frightened	Easily stressed and frightened, Shying, Sensitive to sound, Nervous, Scared, Easily tensed
Unwilling to work	Unwilling to work, Disobedient, Do not want to cooperate, Ignorant, Does not try to do right
Brave	Brave
Other	Characteristics stated once, that did not belong in any other category

The categories made it possible to analyze the results in Minitab 15 using a Chi-square test ("goodness of fit"). It was done to see if there was any statistically significant difference between the disciplines in the relative number of times a certain category (or answers categorized into that category) was stated by the respondents. Two tests were done, one using the temperamental characteristics stated as wanted by riders, and the other using those that were stated as unwanted.

5. Literature review

5.1. Terminology difficulties

Writing on topics involving horse temperament is complicated as there is a lot of terminology difficulties to consider. In the literature, many different terms are used without a consistent and clear definition, for example mental characteristics (Visser, 2002), temperamental traits (Visser et al, 2001; Momozava et al, 2007; Lansade et al, 2008b; Nagy et al, 2010), temperamental characteristics (Visser et al, 2002), temperamental dimensions (Lansade and Simon, 2010), personality (Lloyd et al, 2007), personality profiles (Grajfoner, 2010), personality traits (Anderson et al, 1999; Visser et al, 2003b), personality dimensions (McGrogan et al, 2008) and personality characteristics (Morris et al, 2002). This is confusing and results in difficulties in the comparison of results, especially since the trait or characteristic actually measured in the test often also lacks consistent definition (Mills, 1998), and adverbs and adjectives are used together (Bridgeman, 2009). Additionally, the same aspect of temperament or personality has been studied under various different headings (Napolitano et al, 2008). People in connection to horses commonly use expressions like excitable, laid-back and stubborn to describe horses, and assume that it will be understood by others (Waran et al, 2007). To some extent, these expressions are also used in the scientific literature, even though they have no specified meaning and cannot be validated in a scientific context (Mills, 1998).

We know that horses differ in how they cope and respond to challenges such as changes in environment or handling routine. These differences are commonly seen as differences in temperament (Visser, 2002). However, as temperament is defined as a "person's or

animal's nature that permanently affects its behaviour" (Oxford dictionary of English, 2003) it is essential that these differences in temperament are consistent over time (Visser, 2002). The responses to challenges are measured by quantifying behavioural variables (Visser et al, 2002) and are referred to as traits ("distinguishing quality or characteristic, typically belonging to a person" (Oxford dictionary of English, 2003)) or characteristics ("typical of a particular person" (Oxford dictionary of English, 2003)). The "combination of these characteristics or qualities that form an individual's distinctive character" makes up the personality (Oxford dictionary of English, 2003) which differs from temperament in that it is not apparent at birth (Morris et al, 2002).

With this background, I have decided to use the term temperamental characteristic in this project with the definition: "a permanent (consistent over time and across situations) way of behaving that is typical of a particular horse". This means that terms like "fearful, willing to work, easily frightened" etc are considered temperamental characteristics.

5.2. The need of a method for measuring temperamental characteristics in horses

A method for measuring temperamental characteristics that is built on facts rather than opinions (Visser, 2002) and is quick, simple and interpretable in practical situations would be highly important for people dealing with animals (Seaman et al, 2002). Training, welfare, breeding and performance of horses are other areas where it has implications (Momozava et al, 2003).

A horse's temperament can determine its success in a specific discipline or at a given type of work (Mills, 1998) since it is the mixture of a "winning temperament" and excellent physical abilities that creates a winning athlete (Visser et al, 2001). This is why people throughout history have searched for horses with certain temperamental characteristics, suitable for their intended use (Mills, 1998). Therefore, temperamental characteristics have also been a goal when breeding for display and sport purposes (Morris et al, 2002). To increase the prevalence of preferred temperamental characteristics in the horse population, it is commonly included as a breeding objective.

"Behaviour" is included in the verbal breeding objective definitions in 11 out of 19 European breeding organisations for warmblood horses (Koenen et al, 2004), and breeding horses are subjectively evaluated for temperament and character during a performance test in many European countries (Mills, 1998). If objective tests are developed, the mean heritability for temperament characteristics will increase and the selection of breeding stock can be done with greater confidence (Mills, 1998).

A better understanding of temperament in horses can be of help when selecting horses for an intended use. Evaluating the most suitable task for a certain horse is also a legislative demand, as Swedish law states that expectations of performance during training and competing with animals have to be adjusted to the individual animals physical and psychological capabilities (2 kap. 2 § Djurskyddsmyndighetens föreskrifter (DFS 2005:2) om träning och tävling med djur, saknr L17). Measuring temperamental characteristics would make it easier to find horses suitable to perform in a specific discipline, for leisure riding with amateur riders (Lloyd et al, 2008) horses suitable for animal-assisted therapy, police or military services (Grajfoner et al, 2010). It can also contribute to the understanding of behavioural problems (Seaman et al, 2002). If it was possible to select a horse for a rider that met his or her expectations regarding capability and suitability for the intended use, this would improve the welfare of horses (Lloyd et al, 2008; Flentje and Creighton, 2010).

The evaluation of horse temperament can also have implications for management and training, which is very important, as horses in Sweden should be housed and managed in a way that promote their health and give them the opportunity to express natural behaviours (4 § djurskyddslagen (1988:534)). It has been suggested that horses with a certain temperament may adapt to environmental challenges easier or more difficult than others (Seaman et al, 2002) and need different conditions to learn optimally. This would make it possible to develop an appropriate training programme for each specific horse (Lansade and Simon, 2010). The tendency to get stressed due to isolation from conspecifics is another interesting aspect of equine temperament, which has implications for use and welfare. Horses are expected to perform isolated during most competitions, and excessive reactions to this can result in the horse loosing its concentration on the task and being difficult to handle (Lansade et al, 2008).

Measuring horse temperament can also have economic implications. Hennessy et al (2008) found in their study that when selecting a horse, purchasers rated temperament higher than for example movement, performance and competition experience. Another benefit is that a test can detect horses that reliably are expected to perform well as competition horses, allowing costly investments to be spent solely on them (Visser et al, 2003c). An adapted training schedule and selection of horses for suitable tasks instead of assuming that they all fit for all tasks may save money and time (McGreevy, 2007).

5.3. Which factors affect the way a horse behaves?

The behaviour of a horse is influenced by many factors, and certain temperamental characteristics have spread in the population due to their evolutionary benefits. Thus, characteristics such as being sociable, aggressive and anxious may have increased an individual's survival in the wild (Morris et al, 2002). This spreading in the population is possible due to that, to some extent, behaviour and personality have a genetic basis (Reif and Lesch, 2003; Mormède, 2005) and there is a long history of breeding for certain temperamental characteristics in animals for performance and display (Morris et al, 2002). These breeding efforts resulted in breeds that differ in temperament (Lloyd et al, 2008). In a test that examined fearfulness and gregariousness, Wolff et al (1997) found that half siblings reacted more similarly than unrelated horses, suggesting that these characteristics are affected by genes. The management of domestic horses may also affect their behaviour as Søndergaard and Halekoh (2003) found that social environment and type of housing affected horses' reactions to humans. In addition, the use of the horse has impacts, competition horses have been reported to show higher levels of trainability and lower levels of anxiety than leisure horses (Nagy et al, 2010). Trainability may also be affected by the presence of stereotypic behaviours, although the results are contradicting. Hausberger et al (2007) found it to be connected to learning impairments while Nagy et al (2010) did not find any relationship between these factors.

5.4. Different methods used to measure temperament in horses

During the last decade, the interest from scientists in equine temperament research has largely increased (Visser et al, 2008). Temperament has been assessed quantitatively through behavioural tests (Visser et al, 2008) using scoring of behaviour responses to different stimuli or the examining behavioural parameters (Momozava et al, 2003), and qualitatively by surveys, questionnaires and observer ratings (for example by trainers, riders, judges and handlers) (Visser et al, 2008). Physiological measures of autonomic (heart rate and respiration) and endocrine functions have also been used (Momozava et al,

2003). A short summary of the methods is shown in Table 2. Taylor and Mills (2006) identifies requirements for tests assessing temperamental characteristics and argues that they should use a standardized protocol, measure scientifically valid and reliable parameters and be feasible in practice. Existing methods have been criticized, for example by Seaman et al (2002), who argues that there is a lack of objectivity and consideration of the stability over time, and that behaviour tests may only have a value in finding horses that express extremes. Morris et al (2002) writes that challenges towards reliable judgments of personality characteristics comes from "the precision and stability of the measurement, behaviour in judges in using the instrument, the nature of persons or elements to be evaluated, or any combinations of these". To increase the reliability of the tests, some authors have combined methods (Hausberger et al, 2008) such as the combined use of observer ratings, behavioural tests and physiological measures (Bridgeman, 2009).

Table 2. Different methods used to measure temperamental characteristics

Method	What is evaluated?	How is it measured?
Observer rating	A horse's behaviour in its domestic environment.	A person familiar to the horse (for example trainer, rider or handler) gives an evaluation of the horse through a questionnaire or survey.
Behavioural test	A horse's behavioural responses to different challenging situations.	A horse is confronted with a challenging situation during standardized experimental conditions. Behavioural responses are recorded.
Physiological measures	Responses of horse's autonomic nervous system to different challenging situations.	A horse is confronted with a challenging situation during standardized experimental conditions. Autonomic functions such as heart rate, respiration and endocrine levels are measured.

5.4.1. Observer ratings

An observer rating, survey or questionnaire, is built on an evaluation of the horse's behaviour in its domestic environment (Hausberger et al, 2008) as it is perceived by for example trainers, riders, judges or handlers (Visser et al, 2008). The method can be used either with multiple questions to evaluate many aspects of a horse's personality, or by asking the respondent to assign a grade on general impression (McCall et al, 2006) which will generate a judgement in terms of for example bold, timid or friendly (Napolitano et al, 2008). Many different approaches have been used, for example questionnaires containing large number of adjectives (McGrogan et al, 2008), using line-ratings (Visser et al, 2003a) or allowing the respondents to develop their own vocabulary and descriptive categories (Napolitano et al, 2008). This is useful as the interpretation of terms used in questionnaires and surveys varies between individual people, but they can be expected to be consistent in the use of their own vocabulary over time and situations (Bridgeman, 2009). Some authors have been inspired by research on human personality (Hausberger et al, 2008) and for example the five-factor model that makes it possible to place personality descriptors into five factors have been used (McGrogan et al, 2008).

There are several advantages when using observer ratings. The temperament is evaluated under various circumstances (Momozava et al, 2002) and during a long time, which means that temporary changes of temperament resulting from physical condition will not disrupt the result. The method is also very effective, as it allows many traits to be assessed

simultaneously (Momozava et al, 2005). However, there are also disadvantages. The use of the method is very limited for unfamiliar horses as the reliability is dependent on the respondent's experience (daily care and training) of the target horse (Momozava et al, 2003). The respondent also has to ignore personal preferences and be blind to treatment and impartial to factors like breed, utilization and pedigree to accurately assign scores (McCall et al, 2006). The ratings or scores has to be carefully interpreted. As Podberscek and Gosling (2002) argue, the ratings will give information not just about the animal evaluated, but will also reflect the respondent and the interaction between the two. For example Visser et al (2008) found that riders liked to ride horses that showed evasive behaviour when ridden, and that were reactive and sensitive to the environment. They suggest that it is due to that some riders enjoy the challenge of cooperating with more difficult horses.

The results on the validity from observer ratings, assessing equine temperament traits are contradicting. Momazava et al found in two studies (2003; 2005) that questionnaires are valid and effective when assessing reactivity, anxiety, trainability and affability and Visser et al (2003a) found that riders agreed on temperamental traits in horses. However, Anderson et al (1999) reports that instructors at a therapeutic riding centre did not often agree on the temperament on their horses, Mills (1998) writes that instructors familiar with the horses assessed them differently and Diviero (2010) found that trainers could agree on behavioural assessment but it did not correlate with the validations from judges. Visser et al (2003a) writes that contradicting results might be due to the fact that the persons evaluating were experienced and familiar with the horses, and might have had personal preferences with the individual horses. Anderson et al (1999) suggests that it can also be due to that the horses behave differently towards different people. Apart from this, the use of respondents with different experience of horses, nationality and cultural backgrounds may play a significant role (Napolitano et al, 2008).

5.4.2. Behavioural tests

In behavioural tests, horses are challenged to response to different stimuli (Visser et al, 2008) and behaviours are fragmented and put into discrete mutually exclusive categories using ethograms (Napolitano et al, 2008). Most commonly, horses are observed in an arena were they are confronted with novel objects or handled (Bridgeman, 2009). Unknown animals can be assessed, and the test is objective (Momozava et al, 2003) which means that it can be standardized, a minimum requirement of quality (Taylor and Mills, 2006). This is advantageous when used in different locations (Visser et al, 2003a). Variation is not caused by perception, so there is no need for large panels of observers (Visser et al, 2001), however, there is more work involved in performing the tests and analysing the gathered data (Visser et al, 2008). The results of the tests are very dependent on the situation, so horses have to be challenged to show responses in many different tests. Otherwise it will not lead to a full picture of the temperament (Visser et al, 2008), especially due to the fact that previous experiences can affect the responses to certain stimuli, which is a problem in older horses (Seaman et al, 2002). It is also important that many different variables from different classes of behaviour are evaluated simultaneously in a test to get the full picture (for example postural expressions, vocalisations, locomotion or position in relation to challenge), as one individual variable can show great inter-individual variation (Visser et al, 2001). However, horses are assessed in very experimental conditions, so relating the responses in specific circumstances to real life might still be difficult (Momozava et al, 2003) but is necessary, since the test has to be interpretable in practical situations to be of any use (Seaman et al, 2002).

There are several problems and concerns with the use of behavioural tests to assess temperament in horses. Seaman et al (2002) argues that behavioural responses are categorised as for example fear without validation, and that the relationship between response and underlying motivation is not investigated. It has also been questioned if the results from the tests are stable over situation and time. Seaman et al (2002) writes that day-to-day variation causes the temperament evaluation to depend on testing day and Lansade et al (2008a) describes it like a "snapshot", that is only valid at a given time and situation. If a horse's responses in a test are not consistent over time and situation, it cannot be considered to measure temperament. The responses are then merely an expression of a psychological state, in response to a specific situation (Bridgeman, 2009). In studies where tests have been repeated, most tests were only moderately reliable and behavioural variables indicating temperamental traits lacked consistency (Visser et al, 2001; Seaman et al, 2002; Creighton and Flentje, 2010). However, if the tests are repeated, habituation is a concern (Seaman et al, 2002).

5.4.3. Physiological measures

Studies that compare physiological measures and temperament in horses are very scarce (Anderson et al, 1999). Individuals' autonomic nervous system respond differently to challenging situations, which can reflect different temperaments (Visser et al, 2002), and measures have primarily been done to strengthen the interpretation of responses in behavioural tests (Visser et al, 2003a). Heart-rate, respiration and endocrine levels have been used (Momozava et al, 2003) but their validity are questioned due to the large influences by physical activity (Momozava et al, 2007), uncontrollable events (Lansade et al, 2008b) or the act of sampling (hormone-levels) (Hausberger et al, 2008).

Heart rate was considered a poor indicator for reactivity to humans (Lansade and Bouissou, 2008) and reactivity (Lansade, 2005) as it did not correlate with the best behavioural indicators. However, Visser et al (2002) reports that heart-rate variability was a reliable indicator of temperament in a bridge test as it was consistent over years. This leads to the suggestion that the type of cardiac measure used is important (Lansade et al 2008b). Lansade and Bouissou (2008) argue that it is very sensitive, non-specific and dependent on precise methodology. Temperament, reactivity and hormone concentrations (concentration of plasma cortisol, norepinephrine and epinephrine) were studied by Anderson et al (1999). They found no correlation, but a tendency for relationship between extremes in temperament (for example extremely low or high reactivity) and hormone concentration.

5.4.4. Tests combining methods

To test the reliability, methods have been combined to assess equine temperament (Hausberger et al, 2008). In a study where emotionality scores based on general impression were compared with a behavioural test and physiological measures poor correlations were found (McCall et al, 2006) and Seaman et al (2002) reported no relationship between subjective ratings from farm leaders and results from an objective behavioural test. However, Napolitano et al (2008) and Le Scolan et al (1997) found that scores given by a riding instructor correlated with results from a behavioural test, Visser et al (2003a) found that riders' ratings correlated with heart-rate variables in a behavioural test and Momozava et al (2003) reports relationship between results from a questionnaire, heart-rate measures and a behavioural test. The contradicting results might be due to the use of different methods (McCall et al, 2006).

5.5. Specific tests for the measure of certain temperamental characteristics

Different tests have been used in studies to measure temperamental characteristics in horses, but most of them can be divided into three categories depending on which characteristic they are primarily measuring; (1) emotionality (a very broad term), (2) learning abilities and (3) reactions to human handling (Visser et al, 2008). These are also suggested to be the most relevant aspects for achieving optimal performance in a horse Visser (2002). Some tests developed specifically for the evaluation of these temperamental characteristics are shown in Table 3. However, many additional tests that are not mentioned (used in for example a single study) exists in the literature.

Table 3. Commonly used tests designed to measure certain temperamental characteristics

Temperamental characteristic	Test	Test procedure	Used by for example:
Emotionality or emotional reactivity	Arena	A horse is let loose in a familiar environment and its responses are recorded.	Le Scolan et al, 1997 Seaman et al, 2002
	Open field	A horse is let loose in an unfamiliar environment and its responses are recorded.	Napolitano et al, 2008
	Novel object	A horse is let loose and presented with a static or moving novel object and its responses are recorded.	Anderson et al, 1999 Visser et al, 2003c Lansade et al, 2008b Lansade and Simon, 2010 Momazava et al, 2003 Lansade et al, 2007 Winter Christensen et al, 2005
Reactions to human handling	Touch human	Time until horse loose in open area touch familiar or unfamiliar human.	Søndergaard and Halekoh, 2003 Lansade and Bouissou, 2008 Lansade and Simon, 2010 Seaman et al, 2002
	Let human touch	Time until familiar or unfamiliar human are able to touch loose horse.	Søndergaard and Halekoh, 2003 Lansade et al, 2007 Lansade and Bouissou, 2008
	Bridge test	A human handler leads horse over elevated surface.	Visser et al, 2003c Visser et al, 2008
Learning abilities or trainability	Avoidance	A horse is expected to learn a task to avoid a negative experience.	Visser et al, 2003b Lansade and Simon, 2010
	Reward	A horse is expected to learn a task to receive a reward.	Visser et al, 2003b Lansade and Simon, 2010

5.5.1 Emotionality or emotional reactivity

Emotionality, or emotional reactivity (Visser, 2002), can be described as a heightened state of arousal (McCall et al, 2006). It can be further divided into different aspects, such as

fearfulness or reaction to social separation (called gregariousness) (McCall et al, 2006). The level of emotionality in a horse can affect its suitability for specific tasks (McCall et al, 2006). Behavioural parameters that can be useful to measure when looking at emotionality are for example locomotory reactions (such as flight responses and attempts to escape), vocalizations or defecation (McCall et al, 2006). Humans should not be present during the test, since this can influence the behaviour of the horse (McCall et al, 2006).

To measure emotional reactivity, two types of tests are frequently used in the literature (Hausberger and Richard-Yris, 2005), those are the arena/open field test and the novel object test. In the arena- (used by for example LeScolan et al (1997) and Seaman et al (2002)) and open field- (used by Napolitano et al (2008)) tests, a horse is let loose and its behaviour is recorded. The difference between the two tests is that in an arena test the arena is familiar to the horse, and in a classical open field test it is not (Visser, 2002).

The problems associated with the classical open field test are the difficulties to know whether it is testing exploration, fear, social motivation or a combination of these. Using an environment that is familiar to the horse, such as in an arena test, addresses some of these concerns that can be affecting the results (Visser et al, 2001). However, as horses are strongly group-living animals, these kind of tests will always be strongly affected by how horses react to isolation from conspecifics (Seaman et al, 2002), also termed amount of gregariousness (Wolff et al, 1997). The importance of this characteristic has rendered special attention and it has been measured in specific tests. Lansade et al (2008a) conducted tests where a horse was taken away from conspecifics, left behind when conspecifics were taken away, given the opportunity to rejoin conspecifics and passed along other horses.

In the novel object test, which is assumed to reflect the fearfulness of the horse (Wolff et al, 1997), the horse is let loose and presented to a static or moving novel object, while its behaviours are recorded (Hausberger and Richard-Yris, 2005). Being a prey species, exploration of novel, potentially dangerous things is not an appropriate response from a survival point of view (Winter Christensen et al, 2005). Therefore, it is argued by Winter Christensen et al (2005) that the results of this test are dependent on that the horse is motivated, for example through food reward, to approach the object. Otherwise, the result may just reflect that the horse is not interested in the object, and not the degree of emotional reactivity in itself (Winter Christensen et al, 2005). However, other authors do not express concern over motivation in their reports. Different things have been used as novel objects, both static and appearing suddenly as surprise, for example umbrellas (Anderson et al, 1999; Visser et al, 2003c; Lansade et al, 2008b; Lansade and Simon, 2010), balloons (Anderson et al, 1999; Momazava et al, 2003), a vocalizing toy pig (Anderson et al, 1999), tires (Lansade el al, 2007) and plastic cones (Winter Christensen et al, 2005; Lansade et al, 2007). Even noise and smell (eucalyptus oil) have been used (Winter Christensen et al, 2005).

Other types of tests to measure emotionality have been used that do not fall under either category described above. For example tests where horses walked loose over a novel surface (Lansade et al, 2008b; Lansade and Simon, 2010) was left alone tied in a novel room (Momazava et al, 2007) or confronted with a restraint covering its head and having a holiday garland shaken inside the stable (Minero et al, 2005). Apart from behavioural tests, also observer ratings can be used to assess emotionality as Momozava et al (2005) found that anxiety could be assessed reliably through a questionnaire.

5.5.2. Reactions to humans

Methods for measuring reactions to humans have been developed quite recently, and through a variety of approaches (Hausberger et al, 2008). This characteristic is complicated, since horses are expected to have trust in humans to not act as predators, still respect humans as dominant individuals and perform and cooperate with us (Visser, 2002). Still, it is crucially important, since horses fearful of humans will be stressed and dangerous to handle when human contact can not be avoided (Søndergaard and Halekoh, 2003) and the success in riding is dependent on human-horse interaction (Visser et al, 2008). In literature, horses' reactions to humans have been measured through; responses to a human suddenly appearing at the stable door (Hausberger and Muller, 2002) or walking into the stable (Zucca et al, 2010), time until animal touch familiar or unfamiliar human when loose in an open area (Søndergaard and Halekoh, 2003; Lansade and Bouissou, 2008; Lansade and Simon, 2010) with and without eye contact (Seaman et al, 2002) or time taken for familiar or unfamiliar human to be able to touch a loose horse (Søndergaard and Halekoh, 2003; Lansade et al, 2007; Lansade and Bouissou, 2008). Scientists have also looked at posture of head and direction of gaze of a horse when a human is presented (Hausberger and Muller, 2002). There are also handling tests, for example time taken to fit a halter (Lansade and Bouissou, 2008) and bridge tests where a human handler leads the horse over an elevated surface. This test measures the cooperation in a situation of performance (Visser, 2002) and has been conducted using a bridge made of concrete plates (Visser et al, 2003c) and plywood (Visser et al, 2008).

5.5.3. Learning abilities or trainability

Learning abilities, or trainability (Nagy et al, 2010) in a horse is the ability to associate and give a desired response when presented with a cue or stimulus (Visser, 2002) Tests designed to measure this characteristic have varied greatly (Hausberger and Richard-Yris, 2005). Both reward learning avoidance learning are commonly used when training horses, and therefore, it is important to measure both to get a true picture (Visser, 2002). Avoidance tests described in the literature have involved crossing a bar at the sound of a bell to avoid a puff of air (Visser et al, 2003b; Lansade and Simon, 2010) and reward tests have involved the horse having to put its nose in one out of two food trays to receive a reward in the other (Visser et al, 2003b) or step forward and backward to receive a treat (Lansade and Simon, 2010). There have also been instrumental tasks, for example raising a lid with the nose to open a chest (Hausberger et al, 2007), and learning tests in stressful situations (Lansade and Simon, 2010). Momozava et al (2005) question the use of behavioural test to assess learning ability since for example fear of the test situation may disturb learning. The use of a questionnaire is suggested, as have been found to be a reliable way of assessing trainability (LeScolan et al, 1997; Momozava et al, 2005; Nagy et al, 2010).

6. Results of questionnaire

6.1. Which temperamental characteristics are wanted in a jumping/ dressage horse?

A total of 18 respondents training jumping or dressage answered the question. 7 riders training jumping stated 18 wanted temperamental characteristics. Answers belonging to the category "*Willing to work*" was stated 8 times, "*Listens to the rider*" 5 times, "*Brave*" 4 times and "*Other*" 1 time. 11 riders training dressage stated 31 wanted characteristics. Answers belonging to category "*Willing to work*" was stated 13 times, "*Listens to the rider*" 14 times and "*Other*" 4 times. The results from the questionnaire are illustrated in Fig.1.

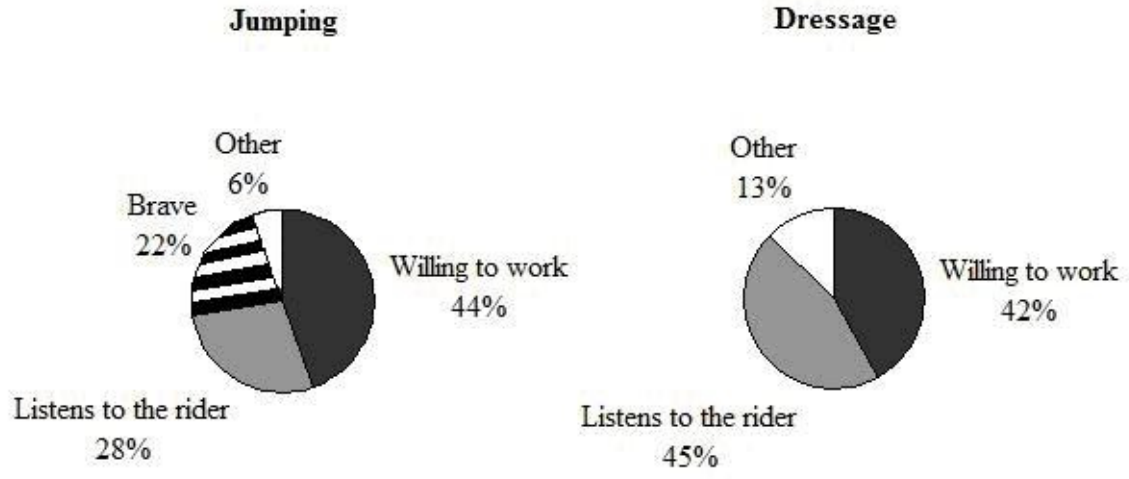

Fig 1. Pie charts of temperamental characteristics wanted in a jumping/dressage horse.

The analyses did not show any statistically significant differences between the temperamental characteristics wanted by riders training jumping or dressage. However, the willingness to work was found important in both disciplines (44 and 42% respectively) and there is a higher tendency for riders training dressage to appreciate that the horse listens to the rider than riders training jumping. Only riders training jumping mentioned the characteristic "*Brave*".

6.2. Which temperamental characteristics are unwanted in a jumping/dressage horse?

A total of 18 respondents training jumping or dressage answered the question. 7 riders training jumping stated 17 unwanted temperamental characteristics. Answers belonging to the category "*Easily stressed and frightened*" was stated 5 times, "*Unwilling to work*" 10 times and "*Other*" 2 times. 11 riders training dressage stated 29 unwanted characteristics. Answers belonging to category "*Easily stressed and frightened*" was stated 16 times, "*Unwilling to work*" 10 times and "*Other*" 3 times. The result from the questionnaire is illustrated in Fig.2.

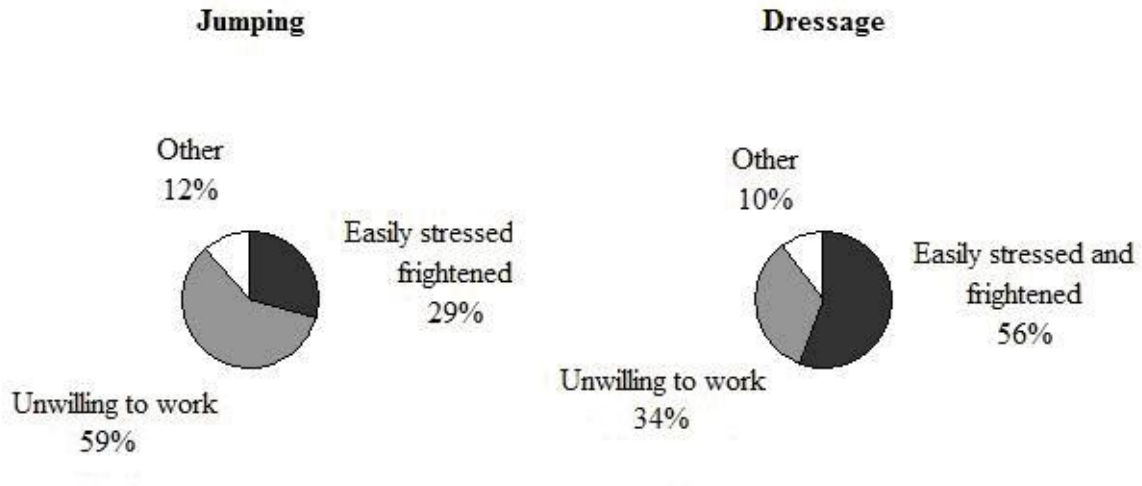

Fig 2. Pie charts of temperamental characteristics unwanted in a jumping/dressage horse.

The analyses did not show any statistically significant differences between the temperamental characteristics unwanted by riders training jumping or dressage. However, the characteristic "*Unwilling to work*" were found most important to avoid in jumping horses and "*Easily stressed and frightened*" were more important in dressage horses.

7. Discussion

The great number of recently published articles reveals that equine temperament is now receiving more and more attention from scientists around the world. Many tests for the evaluation of different aspects of temperament have been developed, and knowledge is increasing rapidly. Unfortunately, the use of inconsistent and poorly defined terminology makes it difficult to compare studies and their results. The test procedures used to evaluate equine temperament are however often better described than what is actually measured by the tests, and these procedures, the methods, became focus of the literature review in this degree project. The results revealed that to evaluate temperamental characteristics in horses, behavioural tests, observer ratings, physiological measures and combinations of these are most commonly used. Most tests have focused on evaluating emotionality or emotional reactivity as well as reactions to humans and learning abilities or trainability, which are thought to be the most important aspects of temperament when aiming for optimal performance in equestrian sports (Visser, 2002).

From the answers to the web-based questionnaire used in this study, no statistically significant differences were found in the preference for, or avoidance of, certain temperamental characteristics between riders training jumping or dressage. However, the results revealed that riders searched for "*willing to work*", "*listens to the rider*" and "*brave*" (only stated by riders training jumping) and avoided "*easily stressed and frightened*" and "*unwilling to work"*. When looking at the results from the questionnaire, it is important to bear in mind that the study had a low answer rate (40%) and only 21 respondents. All the respondents were professional riders, so the results cannot be argued to be representative for all riders training jumping or dressage, or amateur riders. There were also some confusion regarding the definition of a temperamental characteristic, and respondents seemed to interpret this very differently. The decision to categorise the answers was necessary for the analyzing of the results, but imposes a degree of subjective

judgement in deciding in which category to place the answer. This taken together means that the result should be very carefully interpreted.

The temperamental characteristics found important by riders training jumping or dressage can be further divided into two categories; those related to (1) reactions to the environment, including "*easily stressed, frightened*" and "*brave*", and (2) cooperation with humans, including "*willing to work*", "*listens to the rider*" and "*unwilling to work*". Some of the existing tests used for assessing emotional reactivity or emotionality can probably be used to assess characteristics in the first category. It is important to find which behaviours or parameters that are relevant to measure when evaluating these characteristics, and then find out which test that is most suitable for measuring these. A minimum requirement on the test is also that is meets the requirement for a test to assess temperamental traits that are set up by Taylor and Mills (2006). This means that it needs to include a standardized protocol, the parameters assessed should be scientifically valid and reliable, and in order to be used in practice the test should be feasible (Taylor and Mills, 2006). Scientific behavioural tests often focus on visual stimuli, but noises and sudden appearance might be more important since horses have a different perception of the world than humans do. More research is needed in this area to be able to develop tests focused on the stimulus most important from the horse's point of view. One way to find which stimuli to use when conducting the test can be to ask riders in which situations it is most troublesome if the horse is frightened or stressed, and evaluate which stimuli are present and what type of situation it is.

Measuring cooperation with humans in an objective test is very difficult since this characteristic is so dependent on human-horse relationship, and if they are a good match. It can even be questioned if it is a true temperamental characteristic, since it is so dependent on the human involved. It is important to identify ways of defining terms such as "cooperative", "positive to work" and "listens to the rider", as all evaluations otherwise will be built on subjective ratings and individual interpretations of the words. Unless it is possible to find behavioural responses in a certain situation associated with this characteristic, the use of a behavioural test is not possible. Since the characteristic is so dependent on human influence, there will always be concerns regarding if the results are due to true differences in temperament in horses or other aspects. A test to measure how well a horse listens to its rider by measuring the horse's response to for example leg aids could be affected by both the horse's willingness to respond, but also its understanding (from earlier training) of the aid given. However, it might be possible to evaluate how horses tend to cooperate with most humans. For future research, using a questionnaire answered by an objective person such as an instructor at a riding school might be appropriate, as they watch the same horse cooperate with many different riders over a long period of time.

In addition to the discussion on how the temperamental characteristics found relevant to riders training jumping or dressage could be measured, it is also interesting to comment on some of the similarities and differences between the disciplines, even though no statistically significant differences were found. "Willing to work" was considered important in both disciplines and this is not surprising, since willingness to work with and for humans is crucial to a successful relationship and performance in equestrian sports. However, it is important to note that the horse's ability to express this characteristic can be highly affected by aspects such as badly fitted equipment and/or poor riding. "Listens to the rider" was considered the most important temperamental characteristic by riders training dressage, but were also searched for in horses intended for jumping. In dressage, the horse is required to ignore external stimuli and respond correctly to the rider's aids at

all times (Bridgeman, 2009) making the attentiveness of the horse crucial for a good performance.

The opposite to "willing to work" and "listen to the rider" is "Unwilling to work" which was the most avoided characteristic by riders training jumping and was the second most avoided by riders training dressage. It is easily understood why this characteristic is avoided, especially since it might result in dangerous situations for both horse and rider. Highly reactive horses may be difficult to handle and ride, which probably explains why riders of both disciplines avoid the characteristic "easily stressed and frightened". Tension also affects the quality of the horse's gaits, which probably explains why an easily stressed and/or frightened horse was the most unwanted among the dressage riders since it may render bad judge marks.

It is also interesting to note that most respondents of the web-based questionnaire stated very similar characteristics, suggesting that the riders have a very clear and consistent picture of what temperamental characteristics they search for and/or avoid in a horse intended for use in their discipline. However, it would have been interesting with some sort of scores or grades of importance stated together with the temperamental characteristics. Then it would have been possible to know if a characteristic was more or less important than another, and if it differed between disciplines. It is surprising that characteristics such as "friendly" or "bad tempered" were not mentioned at all, since the horse's behaviour towards humans is important for relationship and cooperation. No one mentioned any characteristic related to learning ability or trainability either and this is also considered important for achieving optimal performance in equestrian sports (Visser et al, 2003b). That friendliness is not mentioned may be because the respondents were experienced riders, and thus able and willing to cope with horses more difficult to handle as long as they performed in the discipline. This idea is supported by the findings of Lansade et al (2006) who report that horses successful at jumping or dressage were more fearful, reactive of humans, active, socially motivated and difficult to handle than other horses, who were considered better leisure horses. However, Grajfoner et al (2010) reports that high performance horses were nice, patient, gentle and easy to work with and to handle. It is worth remembering that most horses do not reach top level jumping or dressage but are mostly used for leisure by amateur riders and are then expected to be friendly and easy to handle. This means that from a welfare point of view, it is important to look at which temperamental characteristics are preferred by both competing and amateur riders (and not only try to breed the best horse for elite performance purposes) and include them in breeding goals. This would make it possible to breed horses suitable for performing in equestrian sports, but also for use by amateur riders.

Temperamental characteristics should be measured in terms of numbers or words with no valence. A very high score on sensitivity may for example be very useful to an experienced rider as light aids can be used in the communication with the horse but might troublesome to a novice amateur rider as the horse may respond to and be confused by unintentional signals. Different equestrian disciplines may not only favour different temperamental characteristics, but also different levels or amounts of each characteristic in the horse. Due to this, measures of equine temperament should not be given as "good" or "bad" as how it is perceived is dependent on the combination of human, horse and situation involved.

More research is needed regarding horse temperament, as there is a lack of knowledge in this area that is very important and interesting to everyone involved with horses.

Hopefully, the development of new tests and gaining of knowledge can be stimulated by the many practical implications of this research field (by for example the possibility to increase horse welfare or select breeding stock with greater confidence).To enable future studies to be compared and effectively shared, it is important to use defined terminology and clear descriptions.

8. Conclusion

In this project, it was found that behavioural tests, observer ratings, physiological measures or a combination of these are the most common methods described in the literature used to measure temperamental characteristics. The tests have primarily been used to measure emotionality or emotional reactivity, reactions to humans and learning abilities or trainability. It was found that riders training jumping or dressage considered "*willingness to work*" and "*listens to the rider*" to be wanted and "*Unwilling to work*" and "*Easily stressed and frightened*" to be unwanted temperamental characteristics, but no statistically significant differences in preference for certain characteristics between the disciplines were found. It was argued that existing tests developed for the measurement of emotionality could be used to evaluate some of the characteristic stated as important that were associated with reaction to the environment. However, the characteristics related to cooperation with humans are more difficult to measure. It might be possible to evaluate them using a questionnaire, but it requires the development of a defined terminology using clear descriptions.

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10. References

10.1. Published material

Anderson, M. K., Friend, T. H., Evans, W., Bushong, D. M. (1999) Behavioural assessment of horses in therapeutic riding programs. *Applied Animal Behaviour Science*. **63**, 11-24

Bridgeman, D. J (2009) The working relationship between horse and rider during training and competition for equestrian sports. PhD thesis. University of Southern Queensland

Diviero, S., Tami, G., Marchei, P., Tortiello, C., Catalani, M. C., Barone, A. (2010) Assessing horse performance: A comparison between trainers' and judges' behaviour evaluations. *Journal of Veterinary Behaviour*. **5**. 1, 53-54

Flentje, R. and Creighton, E. (2010) Can standardized behaviour tests predict suitability for use in horses? *Journal of Veterinary Behaviour*. **5**. 1, 58-59

Forkman, B., Boissy, A., Meunier-Salaün., Canali, E., Jones, R. B. (2007) A critical review of fear tests used on cattle, pigs, sheep, poultry and horses. *Physiology and Behavior*. **92**, 340–374

Grajfoner, D. D., Austin, E. J., Wemelsfelder, F. (2010) Horse personality profiles and performance. *Journal of Veterinary Behaviour*. **5**. 1, 26-27

Hausberger, M. and Muller, C. (2002) Short communication: A brief note on some possible factors involved in the reactions of horses to humans. *Applied Animal Behaviour Science*. **76**, 339-344

Hausberger, M. and Richard-Yris, M. A. (2005) Individual differences in the domestic horse, orgins, development and stability. In: Mills, D. S. and McDonnell, S. M. The Domestic Horse: The Orgin, Development, and Management of its Behaviour. *Cambridge University Press.* Cambridge

Hausberger, M., Gautier, E., Muller, C., Jego, P. (2007) Lower learning abilities in stereotypic horses. *Applied Animal Behaviour Science*. **107**, 299-306

Hausberger, M., Roche, H., Henry, S., Visser, E. K. (2008) A review of the human-horse relationship. *Applied Animal Behaviour Science*. **109**, 1-24

Hennessy, K. D., Quinn, K. M., Murphy, J. (2008) Producer or Purchaser: Different Expectations May Lead to Equine Wastage and Welfare Concerns. *Journal of Applied Animal Welfare Science*. **11**, 232-235

Koenen, E. P. C., Aldridge, L. I., Philipsson, J. (2004) An overview of breeding objectives for warmblood sport horses. *Livestock Production Science*. **88**, 77-84

Lansade, L., Bouissou, M.F., Le Pape, G. (2003) Characterization of temperament in young horses. *In: 37th Congress of the International Society for Applied Ethology*, Abano Terme, Italy

Lansade, L., Lévy, F., Bouissou, M.F. (2006) Horse's temperament and suitability for riding activity can be predicted from 8 months of age. In: Mendl, M. (Ed.), *40th International Congress of the International Society for Applied Ethology*, Bristol, UK, p. 234.

Lansade, L., Bouissou, M. F., Boivin, X. (2007) Temperament in Preweanling Horses: Development of Reactions to Humans and Novelty, and Startle Responses. *Developmental Psychobiology*. **49**, 501-513

Lansade, L., Pichard, G., Leconte, M. (2008) Sensory sensitivities: Components of a horse's temperament dimension. *Applied Animal Behaviour Science*. **114**, 534-553

Lansade, L., Bouissou, M-F., Erhard, H. W. (2008a) Reactivity to isolation and association with conspecifics: A temperament trait stable across time and situations. *Applied Animal Behaviour Science*. **109**, 355-373

Lansade, L., Bouissou, M-F., Erhard, H. W. (2008b) Fearfulness in horses: A temperament trait stable across time and situations. *Applied Animal Behaviour Science*. **115**, 182–200

Lansade, L., Simon, F. (2010) Horses' learning performances are under the influence of several temperamental dimensions. *Applied Animal Behaviour Science*. doi:10.1016/j.applanim.2010.02.010

Lansade, L. and Bouissou, M-F. (2008) Reactivity to humans: A temperament trait of horses which is stable across time and situations. *Applied Animal Behaviour Science*. **114**, 492–508

Le Scolan, N., Hausberger, M., Wolff, A. (1997) Stability over situations in temperamental traits of horses as revealed by experimental and scoring approaches. *Behavioural Processes.* **41**, 257-266

Lloyd, A. S., Martin, J. E., Bornett-Gauci, H. L. I., Wilkinson, R. G. (2007) Evaluation of a novel method of horse personality assessment: Rater agreement and links to behaviour. *Applied Animal Behaviour Science*. **105**, 205-222

Lloyd, A. S., Martin, J. E., Bornett-Gauci, H. L. I., Wilkinson, R, G. (2008) Horse personality: Variation between breeds. *Applied Animal Behaviour Science*. **122**, 369-383

McCall, C. A., Hall, S., McElhenney, W. H., Cummins, K. A. (2006) Evaluation and comparison of four methods of ranking horses based on reactivity. *Applied Animal Behaviour Science*. **96**, 115-127

McGreevy, P. (2007) Equine Behaviour. A Guide for Veterinarians and Equine Scientists. Saunders. China

McGrogan, C., Hutchison, M. D., King, J. E. (2008) Dimensions of horse personality based on owner and trainer supplied personality traits. *Applied Animal Behaviour Science*. **113**, 206-214

Mills, D. S. (1998) Personality and individual differences in the horse, their significance, use and measurement. *Equine Veterinary Journal Supplement*. **27**, 10-13

Minero, M., Zucca, D., Canali, E. (2006) Short communication: A note on reaction to novel stimulus and restraint by therapeutic riding horses. *Applied Animal Behaviour Science*. **97**, 335-342

Momozawa, Y., Ono, T., Sato, F., Kikusui, T., Takeuchi, Y., Mori, Y., Kusunose, R. (2003) Assessment of equine temperament by a questionnaire survey to caretakers and evaluation of its reliability by simultaneous behavior test. *Applied Animal Behaviour Science*. **84**, 127–138

Momozawa, Y., Kusunose, R., Kikusui, T., Takeuchi, Y., Mori, Y. (2005) Assessment of equine temperament questionnaire by comparing factor structure between two separate surveys. *Applied Animal Behaviour Science*. **92**, 77–84

Momozava, Y., Terada, M., Sato, F., Kikusui, T., Takeuchi, Y., Kusunose, R., Mori, Y. (2007) Assessing Equine Anxiety-Related Parameters Using an Isolation Test in Combination with a Questionnaire Survey. *Journal of Veterinary Medical Sciences*. **69**, 9, 945-950

Mormède, P. (2005) Molecular genetics of behaviour: research strategies and perspectives for animal production. *Livestock production Sciences*. **93**, 15-21

Morris, P. H., Gale, A., Duffy, K. (2002) Can judges agree on the personality of horses? *Personality and Individual Differences*. **33**, 67-81

Nagy, K., Bodó, G., Bárdos, G., Bánszky, N., Kabai, P. (2010) Differences in temperament traits between crib-biting and control horses. *Applied Animal Behaviour Science*. **122**, 41-47

Napolitano, F., De Rosa, G., Braghieri, A., Grasso, F., Bordi, A., Wemelsfelder, F. (2008) The quantitative assessment of responsiveness to environmental challenge in horses and ponies. *Applied Animal Behaviour Science*. **109**, 342-354

Oxford dictionary of English, Second edition, 2003, Eds. Soanes, C., Stevenson, A. *Oxford university press*, Italy

Podberscek, A. L. and Gosling, S. D. (2000) Personality research on pets and their owners: conceptual issues and review. In: Podberscek, A. L., Paul, E. S., Serpell, J. A. Companion Animals and Us: exploring the relationship between people and pets. *Cambridge University Press*. Cambridge

Reif, A., Lesch, K. P. (2003) Toward a molecular architecture of personality. *Behaviour Brain Research*. **139**, 1-20

Seaman, S. C., Davidson, H. P. B., Waran, N. K. (2002) How reliable is temperament assessment in the domestic horse (Equus caballus)? *Applied Animal Behaviour Science*. **78**, 175-191

Søndergaard, E. and Halekoh, U. (2003) Young horses' reactions to humans in relation to handling and social environment. *Applied Animal Behaviour Science*. **84**, 265-280

Taylor, K, D. And Mills, D, S. (2006) The development and assessment of temperamental tests for adult companion dogs. *Journal of Veterinary Behaviour*. **1**, 94-108

Visser, E, K. (2002) Horsonality: A study on the personality of the horse. PhD thesis. Wageningen University

Visser, E. K., van Reenen, C. G., Hopster, H., Schilder, M. B. H., Knaap, J. H., Barnevald, A., Blokhuis, H. J. (2001) Quantifying aspects of young horses' temperament: consistency of behavioural variables. *Applied Animal Behavioural Science*. **74**, 241-258

Visser, E. K., van Reenen, C. G., van der Werf, J. T. N., Schnilder, M. B. H., Knaap, J. H., Barnevald, A., Blokhuis, H. J (2002) Heart rate and heart rate variability during a novel object test and a handling test in young horses. *Physiology and Behaviour*. **76**, 289-296

Visser, E. K., van Reenen, C. G., Rundgren, M., Zetterqvist, M., Morgan, K., Blokhuis, H. J. (2003a) Responses of horses in behavioural tests correlate with temperament assessed by riders. *Equine Veterinary Journal*. **35**, 176-183

Visser, E. K. Van Reenen, C. G., Schilder, M. B. H., Barnevald, A., Blokhuis, H. J. (2003b) Learning performances in young horses using two different learning tests. *Applied Animal Behaviour Science*. **80**, 311-326

Visser, E. K., van Reenen, C. G., Engel, B., Schilder, M. B. H., Barnevald, A., Blokhuis, H. J. (2003c) The assossiation between performance in show-jumping and personality traits earlier in life. *Applied Animal Behaviour Science*. **82**, 279-295

Visser, E. K., Van Reenen, C. G., Zetterqvist Blokhuis, M., Morgan, K. M., Hassmén, P., Rundgren, T. M. M., Blokhuis, H. J. (2008) Does Horse Temperament Influence Horse-Rider Cooperation? *Journal of Applied Animal Welfare Science*. **11**, 267-284

Waran, N., McGreevy, P., Casey, R. A. (2007) Training methods and horse welfare. In: Waran, N. The welfare of horses, *Kluwer Academic Publishers*, Dordrecht

Winter Christensen, J., Keeling, L. J., Lindstrøm Nielsen, B. (2005) Responses of horses to novel visual, olfactory and auditory stimuli. *Applied Animal Behaviour Science*. **93**, 53–65

Wolff, A., Hausberger, M., Le Scolan, N. (1997) Experimental tests to assess emotionality in horses. *Behavioural Processes*. **40**, 209-221

Zucca, D., Minero, M., Grignani, O., Canali, E. (2010) Reactions of racing thoroughbred horses to an unfamiliar stationary human. *Journal of Veterinary Behaviour*. **5**.1, 97

10.2. Swedish legislation

Djurskyddslagen (1988:534)

Djurskyddsmyndighetens föreskrifter (DFS 2005:2) om träning och tävling med djur, saknr L17