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A Biomechanical Analysis of the Relationship between the Head and Neck Position and the Judgment of a Reining Horse at Backup

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Abstract

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Western riding, especially the discipline reining, is becoming more and more popular in Europe. It is designed to show the athletic ability of horses used for ranch work in the show arena. To be able to understand training methods and requirements in this sport, the focus is set on the horses' proper body position in the various maneuvers.

This research pays particular attention to the backup position of ten different reining horses by analyzing their body positions, giving priority to their head and neck positions to find out how they affect the scoring. Video data is gained at the AQHA European Championship 2012 in Germany as well as at one big training stable in Austria. The measurements are done with skin-fixed markers and marked points, placed on the head, neck, shoulder, croup and limbs of the horses. The horses used in this study are privately owned show horses from Germany, Switzerland, Italy, Great Britain and Austria, in training for competition.

The rulebook says that western judges are looking for a smooth and quick backup. To get a horse smooth and round it needs to lift its back (Heuschmann, 2007 in Rhodin, 2008, p. 41). As the position of the head and neck has a considerable effect on the back of the horse (Heuschmann, 2007 in Rhodin, 2008, p. 19), a relationship was expected between head and neck position and the judgment of three independent international judges.

It could not be proved that the head or neck angle has a significant influence on the judgment of the reining horses, whereas a significant connection to the topline, the combination of head and neck angle, was found after eliminating one horse in cross validation. High correlation was detected in judgment and stride duration as well as judgment and tail angle. The indirect relation for tail angle implies that better scoring was attained with a steep-sided croup. As significant correlation was found for stride duration and neck angle, topline, tail angle and hock angle. According to that relationship, stride duration, also visible as step frequency is seen as a result of an optimal body position and a better indicator of good judgment than the head or neck position.

Westernreiten, speziell die Disziplin Reining, gewinnt in Europa zunehmend an Popularität. Reining zeigt die athletischen Fähigkeiten der ursprünglich für die Arbeit auf der Ranch gezüchteten Pferderassen. Um die komplexen Anforderungen dieser Sportart und das daraus entwickelte Trainingsprogramm zu verstehen, wurde der Fokus der vorliegenden Arbeit auf die optimale Körperposition des Pferdes gelegt.

Die Studie beschäftigt sich mit der ‚Backup – Position‘ von zehn verschiedenen Reining Pferden und beurteilt deren Körperposition mit besonderem Fokus auf die Kopf- und Halshaltung, um deren Einfluss auf die Richterbeurteilung abschätzen zu können. Das Videomaterial dazu wurde im Rahmen der AQHA Europameisterschaft 2012 in Deutschland und in einem großen Trainingsstall in Österreich gewonnen. Die Messungen fanden mit Hilfe von auf dem Fell befestigten Markern und aufgemalten Kontrollpunkten an Kopf, Nacken, Schulter, Kruppe und den Extremitäten statt. Die Studienpferde sind im Training stehende Turnierpferde aus Deutschland, der Schweiz, Italien, Großbritannien und Österreich und sind in privatem Besitz.

Das Regelbuch besagt, dass ein flottes, balanciertes Backup mit weich fließenden Bewegungen als gut zu beurteilen ist. Um die Bewegungen eines Pferdes dahingehend zu verbessern, muss das Pferd ‚rund gemacht‘, also der Rücken gehoben werden (Heuschmann, 2007 in Rhodin, 2008, S. 41). Da laut Heuschmann (2007, in Rhodin, 2008, S. 19) auch die Positionen des Kopfes und Halses einen erheblichen Einfluss auf den Pferderücken haben, wird ein Zusammenhang zwischen der Kopf- und Halsposition und der Richterwertung der drei internationalen Richter erwartet.

Die Studie konnte weder einen signifikanten Zusammenhang des Kopfwinkels noch des Halswinkels mit der Richterwertung feststellen, jedoch wurde nach Ausschluss eines Pferdes, aufgrund der Ergebnisse der Cross Validation, ein Zusammenhang der gesamten Oberlinie, also einer Kombination beider Winkel, erkannt. Einen hohen Korrelationskoeffizienten ergaben die Tests auf Zusammenhang zwischen der Richterwertung und der Schrittdauer als auch zwischen der Richterwertung und dem Schweifwinkel. Ebenso wurden Zusammenhänge zwischen der Schrittdauer und dem Nackenwinkel, der Oberlinie, dem Schweifwinkel und dem Sprunggelenkwinkel gefunden. Aufgrund dessen wurde die Schrittdauer, also die Trittfrequenz, als Resultat einer optimalen Körperposition erkannt und als bessere Beurteilungsmöglichkeit für die Richterwertung angenommen als die Kopf- oder Halsposition des Pferdes.

Key words: western riding, horse; kinematics; head and neck position; body position; reining horse

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Preface

To rein a horse is not only to guide him, but also to control his every movement. The best reined horse should be willingly guided or controlled with little or no apparent resistance and dictated to completely.

(Jim Willoughby, NRHA Hall of Fame Inductee)

Ever since my parents put me on a horse, I have been interested in all different disciplines of Equestrianism. In 2002, after a trip to Wyoming, I started to ride Western and soon encountered plenty of rules and regulations at my first competition.

The idea for this study came to mind when Dr. King, a guest lecturer for biomechanics, engaged us to work out a biomechanical question in relation to our own sport. As we only had the time to search for theoretical solutions, I became eager to find out if my 'theory' about the backup was right and I immediately found support from Dr. Heller and Univ. Prof. Dipl. Ing. Dr. techn. Baca. My aim was to find definitive ways of telling if a maneuver will be judged 'good' or not, still knowing that there is a lot more to it than just one single aspect of motion.

This thesis would not have been possible without the help and support of many people, which I want to express my sincere thanks:

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1 Introduction and aims

Western riding, especially the discipline reining, is getting more and more popular in Europe. Thirty years ago only a hand full of people were interested in this conspicuous hobby. Today, a lot of spare time riders have got to know the merit of this sport. Since 1982 Western riding is professionally done in Austria and lots of great horses found their way to Europe. A lot of different Western riding associations settled in Austria and started organizing shows (competitions).

As this sport is really complex, horse owners have to rely on experienced trainers to find out about show regulations and horse training. When it comes to understanding the judges' expectations in certain maneuvers, the rulebooks are of little help for inexperienced owners.

Focusing on the backup maneuver in 'the reining', the NRHA Handbook (2013) describes judging as follows:

A backup is a maneuver requiring the horse to be moved in a reverse motion in a straight line a required distance; at least 10 feet. [...] credit should be given for smoothness, finesse, attitude, quickness and authority of performing various maneuvers... (NRHA Handbook, 2013, p. 161)

It is easy to measure distance but what about finesse or attitude? Based on that question the aim of this study is to find out what Judges really concentrate on during backup and when they 'plus' the maneuver. Is there a certain body position which helps the horse to 'plus' in its backup?

Concerning smoothness and quickness it is known that, to get a horse smooth and collected¹ it needs to lift its back plus that the position of the head and neck has a considerable effect on the back of the horse (Heuschmann, 2007 in Rhodin, 2008, p. 41). Therefore, this study wants to find out if there is a relationship between the head and neck position and the judgment of a reining horse during backup. Being part of collection, research also factors into hock angle and the position of the croup to find out if there is a certain body position which helps the horse to 'plus' its backup.

The knowledge gained by this study should improve training and help non-professional riders to understand training and aims.

¹ A certain body position with focus on a lifted back; further explained in section 3.2.9

2 Western Riding

2.1 History

There are several opinions about the time when horses were domesticated. Proof could be found in present-day Ukraine for the domestication of horses around 4,500 BC. There is no doubt about the operative roles horses have played for years. They played a military role and were part of warfare in several countries, as well as being used in agriculture, for hunting or as means of transportation (Toms, 2012).

In ancient times horses were only used for working. They had to resist physical and mental pressure as well as being easy to handle but also independent in their work. When Spanish conquerors settled in America, they brought along their cows, horses and sheep. Horses made it possible to populate the country. With the horses, the Spanish also brought along their riding style and characterized 'western horsemanship' in seat and saddlery (Hofmann, 1998).

Similar to Spain, saddles with a high pommel² and cantle³ as well as long stirrups were used in France and Italy to keep the rider in place. Curb bits⁴ and spurs with large rowels were used to collect the horses and use them to traverse geographical barriers, in exploration, hunting and driving cattle (Strickland, 1998).

Western riding has progressed and mixed with classic equestrianism nowadays. Horsemen look for a smooth horse which performs without resistance. Horses react on being touched by the rein and immediately adjust direction. The so called 'neck reining' also comes from necessity and allows a cowboy to guide his horse with only one hand, which would free the other hand to rope with. As Western horses always have to respond to gentle advice, the animals get the idea of moving away from the pressure of the rein really quickly (Strickland, 1998).

Modern horses are asked to move under weight transference, away from leg pressure, and be supple through their head, neck, shoulder, rib cage and hip (Western Equestrian Society, 2012).

² The upper front part of a saddle; a saddlebow.

³ The raised rear part of a saddle.

⁴ A horse's bit to which a curb is attached.

2.2 The different styles

Equipment, teaching methods or signals - it all comes from experience and purpose. Also between one style and another different veins occurred. While English riding comprises disciplines like dressage and jumping, the Western riding divides into classes with and without cattle which will be discussed in chapter 3.1. Specific differences between the English and Western riding style can be found in the cues to the horses in the first place. Western riding relies on short signals while English riding uses constant cues, which means a Western horse has to work a lot more independently. The difference can be observed best when watching the reins. There is a constant connection to the mouth of an English ridden horse, while a Western horseman only gets in contact to show the horse its next task (Ettl, 1998). There is an international discussion about the resulting head and neck position of English and Western horses. Many trainers prefer an extremely low position to strengthen the muscular system of the back (Janssen, 2003).

2.3 The Western Horse

There are a few American breeds which are known as typical Western horses, but also a lot of European horses fulfill the requirements. Riders are looking for intelligence, sensitivity, willingness to learn, as well as strong nerves. To be quick and agile, it needs to have a strong, well-muscled body, featuring a broad chest and powerful, rounded hindquarters. It also needs to be well balanced and of average height. The most common Western breed is the American Quarter Horse (FENA, 1998).

2.3.1 American Quarter Horses

The American Quarter Horse is the best known breed, which is also used for this study. It developed during the times of the European colonies in the east of the USA. By mixing breeds like Arabian horses, Barb horses and later the Galloway pony they bred a powerful, strong and agile horse which was used for herding cattle. As the English always loved racing, they organized street races over the short distance of a quarter mile, where those small, well-muscled horses stood out. This breed owes its name to the 'quarter of a mile'-race. But the Quarter Horse didn't only attract attention for its speed, but also because of its ranching work and its 'cow sense'⁵. Due to their frame they were able to do quick turns and short sprints and could easily turn a cow back to its herd (AQHA, 2013).

Breeding standards require a height of 145cm to a maximum of 160cm, a short but wide head, tight lips as well as wide nostrils, rather small ears and big intelligent eyes. Ideally,

⁵ A natural instinct for anticipating a cow's move.

the neck should join the head at about a 45° angle allowing ample flexion at the poll⁶ so that the horse can breathe easily carrying his head low. The shoulders should also show a 45° angle to the body and merge into the withers⁷ of medium height. Breeders are looking for a wide breast, a well-muscled hind and strong, short bones (AQHA, 2013).

2.3.2 Characteristics of Show Horses

There are approximately fifteen different classes at a horse show, where there is separation between junior horses (3-5 years old) and senior horses (starting at the age of 6 years). Senior horses have to be shown with one-handed, meaning that the rider is only allowed to steer his / her horse with one hand⁸. Furthermore, there are youth classes as well as amateur and an open class for professionals. According to the high number of different show classes horses are required to be up to the mark and breed for its field of application. The Quarter Horse can meet all of these requirements (AQHA, 2013).

Different characteristics are forced in breeding the Quarter Horse. Larger ones are used for the so called 'English-classes' and jumping. Smaller, agile horses are used for cow classes like 'cutting' and 'working cow horse'⁹. For the classic disciplines like 'pleasure' and 'western riding' a horse with steady balanced gaits is looked for. 'Reining' requires a horse to be fast moving and agile on its hindquarters (AQHA, 2013).

⁶ Area behind the horse's ears.

⁷ Point where the neck joins the body. Top of the spiny process of the tallest thoracic vertebrae.

⁸ Originally the second hand was used for roping.

⁹ The different disciplines are explained in section 3.1

3 Western Basics and Rules for Judging

3.1 Show Disciplines for Western Horses

The different classes trace back to the requirements which occurred in ranch work. Today's sport requires even more precision, concentration and gymnastics. As mentioned in chapter 2.3.2 riders show their horses in three divisions:

- ❖ Youth (until the riders' age of 18 years)
- ❖ Amateur, subdivided into
 - Novice Amateur (beginners)
 - Amateur (non pro's)
 - Select (Amateurs' older than 50 years of age)
- ❖ Open

Open classes are often separated in junior and senior classes for horses up to and older than 5 years (AQHA, 2013).

3.1.1 Halter

Horses of the same gender (mares, stallions and geldings) are demonstrated to the judges. Halter horses are supposed to represent the breed standard. There are classes for weanlings¹⁰, one, two and three year olds and older horses (AQHA, 2013).

3.1.2 Showmanship at Halter

As before, the horse is presented at halter. At Showmanship not the horse but the exhibitor is judged. He / She has to show his / her ability to present the horse correctly. 360° turns, the jog, a backup and of course, a stop is required (AQHA, 2013).

3.1.3 Western Pleasure

Riders have to show the judge a well-trained, slowly, smooth and comfortably moving horse, which truly is a pleasure to ride. There should be a loose rein and no visible cues from the rider (Equestrians Unlimited, 2013).

¹⁰ A newly weaned horse; a foal.

3.1.4 Western Horsemanship

In this class the exhibitor is judged for his / her seat, cues and most importantly correct leading and change of gait. Two different areas of responsibility are given: The first task is done individually. All three gaits, turns on the hindquarters, side pass and lead changes are required. The second task is to ride a 'western pleasure' (AQHA, 2013).

3.1.5 Trail

Riders have to follow a precise pattern showing different obstacles, which could occur on any trail ride like doors, bridges, different poles which have to be passed in forward-, sideward- or backward motion. Horse and rider should cross the course in the required gaits. Each manoeuvre can be plus marked with style, correctness and obedience (AQHA, 2013).

3.1.6 Western Riding

This class is ridden following a precise pattern. At the beginning the horse has to move over a pole at a jog, then lope off. There are several cones placed in the arena. The task is to do lead changes wherever the pattern requires. There are points for preciseness, invisible cues and the lead changes themselves. At the end of the pattern a stop and backup are performed (AQHA, 2013).

3.1.7 Reining

In this event horse and rider have to show the athletic ability and perform one of several approved patterns including fast large and slow small circles, lead changes, sliding stops, spins and backups. There are 20 different patterns shown in the rulebook. Cues to the horse should be smart and almost invisible (Equestrians Unlimited, 2013).

3.1.8 Cutting

One cow has to be moved out of a herd of cattle by moving the horse into the herd. The rider places himself / herself between herd and cow and now the horse has to work on its own to try to prevent the cow from returning back. No cues of the rider are allowed at that time. There is a time limit of two and a half minutes to show the horse's ability by using as many cows as wanted (Equestrians Unlimited, 2013).

3.1.9 Working Cowhorse

This class shows the versatility of the working western horse. Two tasks are given: the first task is to lead the horse through a 'reining pattern', the second is to do fence work. The horse has to move a cow at the short and long end of the arena, turn it and bring it to the

middle of the arena and circle it in both directions with speed. The exhibitor has to show the horses ability to control a cow (Equestrians Unlimited, 2013).

3.2 Terminology

There are many terms in Western riding describing maneuvers and motion. Sometimes descriptions vary from the different associations of western riding. To be able to know what is asked in a show, you have to know about the basic rules on the one hand, and have the ability to change your horses' motion pattern on the other hand.

3.2.1 AQHA

The American Quarter Horse Association was established in 1940 in Texas and is the world's largest equine breed registry and membership organization for people interested in Quarter Horses. The association sanctions many competitive events and is head of several independent organizations all over the world. The Austrian Quarter Horse Association is the only Austrian club in charge of breeding Quarter Horses. At the moment, 470 members can be counted, as well as 3,229 Quarter Horses are registered (AQHA, 2013).

3.2.2 NRHA

The National Reining Horse Association is a nonprofit club under the laws of the state of Oklahoma, dedicated to the sport of reining. The aim is to develop judging and public interest as well as serving standards for the worldwide sport (NRHA, 2013).

3.2.3 Reining Pattern

There are different patterns shown in the NRHA Handbook (2013) which have to be worked by the exhibitor as stated. There is an illustration added to give an idea what the pattern will look like. Each participant of the class has to show the same pattern. To help the riders' orientation, three cones are placed on the wall of the arena, one in the center and one on either side of the arena at a distance of 15 meters from the end (NRHA Handbook, 2013).

To give an example what is asked of horse and rider, an extract of the NRHA Handbook (2013, pp. 123-124) should give an idea. The following quotation of Pattern no.1 displays the written directions given to each participant. They are accompanied by an illustration, shown in figure 1.

1. Run at speed to the far end of the arena past the end marker and do a left rollback—no hesitation.

2. Run to the opposite end of the arena past the end marker and do a right rollback—no hesitation.
3. Run past the center marker and do a sliding stop. Back up to center of the arena or at least ten feet (three meters). Hesitate.
4. Complete four spins to the right. Hesitate.
5. Complete four and one-quarter spins to the left so that horse is facing left wall or fence. Hesitate.
6. Beginning on the left lead, complete three circles to the left: the first circle large and fast; the second circle small and slow; the third circle large and fast. Change leads at the center of the arena.
7. Complete three circles to the right: the first circle large and fast; the second circle small and slow; the third circle large and fast. Change leads at the center of the arena.
8. Begin a large fast circle to the left but do not close this circle. Run straight up the right side of the arena past the center marker and do a sliding stop at least twenty feet (six meters) from wall or fence. Hesitate to demonstrate the completion of the pattern. (NRHA Handbook, 2013, p. 123)

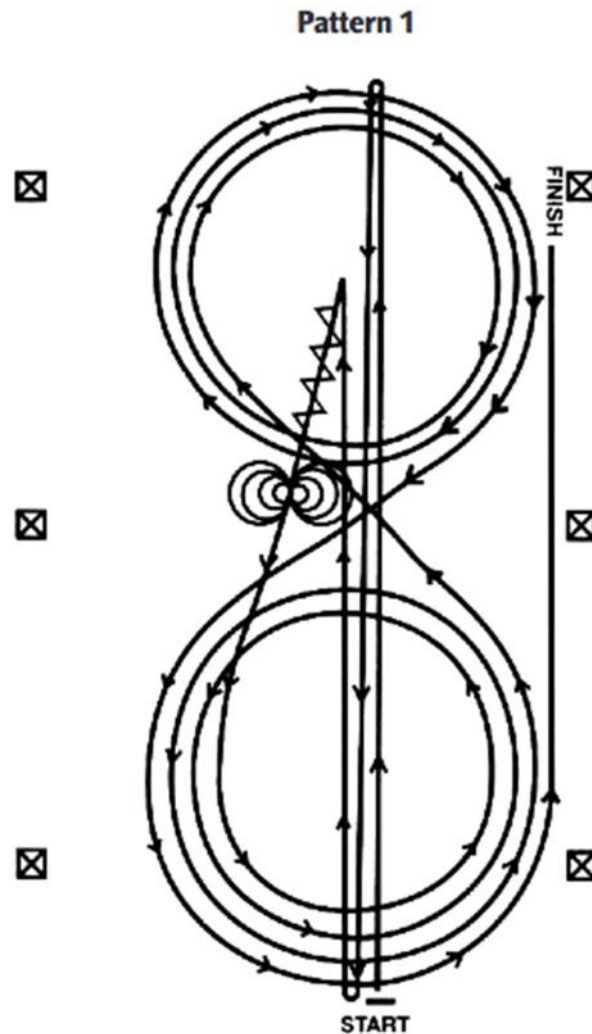


Figure 1: Pattern 1 (NRHA Handbook, 2013, p. 124)

3.2.4 Run Down

A 'run down' is a run through the middle of the arena, either in the middle or along the side with a minimum distance to the wall which should demonstrate control and show a gradual increase in speed to the stop (NRHA Handbook, 2013).

3.2.5 Sliding Stop

In this maneuver the horse has to bring its hind legs under its body to slow down from a lope. This can be done by bending the back and continue moving forward with the front legs. The horse has to stay in a straight line while keeping contact to the ground with the hind feet (NRHA Handbook, 2013).

3.2.6 Backup

When performing a backup, the horse has to be moved in a reverse motion while its body must remain straight. The distance required in a reining pattern is at least 10 feet (NRHA Handbook, 2013).

3.2.7 Aids / Cues

Aids or cues are communication to the horse. While cues are more seen as natural aids, like the leg, voice or seat of the rider, aids can also be artificial. For example spurs (Equestrian and Horse, 2012).

3.2.8 Balance

A horse is in balance when it can carry itself and the rider easily. It has to maintain its center of gravity with its weight distributed, which can only be achieved when the horse lowers its croup and engages its hindquarters well underneath and stays collected (Equestrian and Horse, 2012).

3.2.9 Collection

Although there is no general definition for collection, common points can be found. The hind limbs of the horse always play an important role. To be collected, horses have to bring their weight back on the hind feet to relieve the forehand and create forward motion. The hind limbs bend more and try to step under the center of gravity. The strides become shorter and raise while maintaining freedom of movement and lightness of the forehand. There is a flexion of the hind limbs resulting in a lower croup and the rising of the shoulder and back (Ettl, 1998; GNEF, 2002). Another sign of collection is the so called 'rounded back', an increased flexion of the back (Heuschmann, 2007 in Rhodin, 2008, p. 41).

3.2.10 Resistance

Resistance means that a horse either does not understand or is reluctant to perform a maneuver. Reasons could be physical discomfort as well as new or incorrect cues (Equestrian and Horse, 2012).

3.2.11 Straightness

A horse is straight when its hind limbs follow in line with the forehand and the weight is evenly distributed over its legs (Ettl, 1998).

3.3 Judging Reining

The NRHA Judging System is known for its combination of technical and stylistic elements also considering a 'degree of difficulty' for each maneuver. Reining means to show the athletic ability of horses in the confines of a show arena, but due to the NRHA Handbook (2013, p. 149) there is a lot more in it for a judge:

To rein a horse is not only to guide him, but also to control his every movement. The best reined horse should be willingly guided or controlled with little or no apparent resistance and dictated to completely. Any movement on his own must be considered a lack of control. All deviations from the exact written pattern must be considered a lack of or temporary loss of control; and therefore, a fault that must be marked down according to severity of deviation. After deducting all faults set here within, against execution of the pattern and the horse's overall performance, credit should be given for smoothness, finesse, attitude, quickness and authority of performing various maneuvers, while using controlled speed which raises the difficulty level and makes him more exciting and pleasing to watch to an audience. (NRHA Handbook, 2013, p. 149)

3.3.1 General Rules

The score given for a run is on a basis of zero to infinity, with a defined average of seventy. NRHA patterns consist of seven or eight maneuver groups which are scored separately in one-half point increments from minus to plus one and one-half, which is explained in precise detail in section 5.3. Zero equals a correct maneuver without any degree of difficulty. Exhibitors are judged when entering the arena and conclude with their last maneuver (NRHA Handbook, 2013).

Pattern no.1 is used again to point out the different maneuver groups as shown in the NRHA Handbook (2013, pp. 161-162):

Maneuver 1: Run down the middle, past the end marker, left rollback

Maneuver 2: Run down the middle, past the opposite end marker, right rollback

Maneuver 3: Run down the middle, past the center marker, stop, back up, hesitate

Maneuver 4: 4 right spins, hesitate

Maneuver 5: 4 1/4 left spins, hesitate

Maneuver 6: Left circles departure, large fast, small slow, large fast, lead change

Maneuver 7: Right circles large fast, small slow, large fast, lead change

Maneuver 8: Complete 3/4's of a large fast left circle, run down side past center marker, stop, hesitate (NRHA Handbook, 2013, pp. 161-162)

From this maneuver score with its starting score of seventy, any penalties are deducted to get the final score. The judge has to evaluate the penalties on separate criteria. Penalties must not affect the maneuver score negatively unless the quality of the maneuver was really affected. A five point penalty is given for certain situations like spurring the horse in front of the cinch, holding the saddle with either hand as well as any disobedience shown by the horse, such as kicking, biting or rearing. Whereas breaking gait or freezing in a spin cause a two point penalty. The judges' report, shown on the next page, shows how they derived the final score.

NRHA JUDGES SCORE CARD

Judge _____

Event _____ Date _____ Class _____ Pattern _____

MANEUVER SCORES: -1 1/2 Extremely Poor -1 Very Poor -1/2 Poor 0 Correct +1/2 Good +1 Very Good +1 1/2 Excellent

MANEUVER DESCRIPTION			1	2	3	4	5	6	7	8	TOTAL	PENALTY	SCORE
DRAW	EXH#	PENALTY											
		SCORE											
DRAW	EXH#	PENALTY											
		SCORE											
DRAW	EXH#	PENALTY											
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DRAW	EXH#	PENALTY											
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DRAW	EXH#	PENALTY											
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DRAW	EXH#	PENALTY											
		SCORE											
DRAW	EXH#	PENALTY											
		SCORE											
DRAW	EXH#	PENALTY											
		SCORE											

Judge's Signature _____

Figure 2: NRHA Judges Score Card (NRHA, 2013)

3.3.2 Hierarchy of judges' concern

A judge should always evaluate a ride on the following concerns the NRHA Handbook (2013) specifies:

- ❖ The exhibitor has to be on pattern, which means, he has to show the correct maneuvers as dictated by the determined pattern.
- ❖ The judge then has to estimate whether the maneuver group is being executed correctly concerning the basic elements, regardless any degree of difficulty.
- ❖ If both pattern and correctness are obtained, the degree of difficulty is judged by evaluating smoothness, finesse, attitude, quickness, authority and controlled speed.

It also is of great importance to judge the whole maneuver group. For example, maneuver group number 3 in pattern no. 1 has to be evaluated by the following aspects:

- ❖ The run down the middle
- ❖ The approach to the stop
- ❖ The stop
- ❖ The backup

Judges should always be aware of overstating any of those aspects. As in most sports, judges' decisions are final but can be protracted due to revisions using video (NRHA Handbook, 2013).

4 Prior knowledge and basics

4.1 Biomechanical research history

Biomechanics is used to explain mechanical behavior of living creatures as well as to analyze movements and kinetic forces. The first known animal research on locomotion was done by the Greek philosopher Aristotle titled 'On the movements of animals'. A major breakthrough in gait analysis was achieved in France in the late 19th century. Technical development and computer technology lead equine locomotion research and made analysis of fast movement possible (Rhodin, 2008).

Kinematic analysis, as used in this study, ignores forces and measures the geometry of movement. Most analysis is performed using video graphic systems and quantify temporal, linear and angular measurements describing motions (Clayton/Schamhardt, 2001).

4.1.1 Prior studies

Since 1980 kinematics of horses have been studied and gained data about normal movement patterns in walk, trot and lope (Back, 2001). Clayton (2001) also identified the role of a rider on the kinetics and kinematics of horses by comparing several equestrian sports. Schöllhorn et al. (2006, in Rhodin 2008, p. 19) could prove that professionals are able to affect the head position of horses better than recreational riders. Apart from the ones mentioned, two more studies on the effect of draw reins on limb movements done by Roepstorff et al. 2002, in Rhodin 2008, p19) and Byström et al. (2006, in Rhodin 2008, p. 19) could be found.

4.1.2 Knowledge of today

Literature states that the head and neck positions have a considerable effect on the horse's back (Rhodin, 2008; GNEF, 2002). There are several considerations on the influence of head and neck position on motion patterns, but only one study, by Rhodin (2008), that could prove the impact on the movements of back and limbs on ridden horses. She pointed out that a high head position most notably reduces the lateral bending in the lumbar back and significantly shortens stride length. Extremely high head positions lead to vertical limb movement and high limb flexion.

Rodin's (2008) studies were done in walk and trot and confirmed a significant influence of the head and neck on the back movement in both gaits. A high position reduces the ROM for flexion and extension and leads to a higher ROM for the pro- and retraction of the hind

limbs. Recent studies also recognized parallels between the hind limb motion and the back (Faber et al., 2001 in Rhodin, 2008, p. 37).

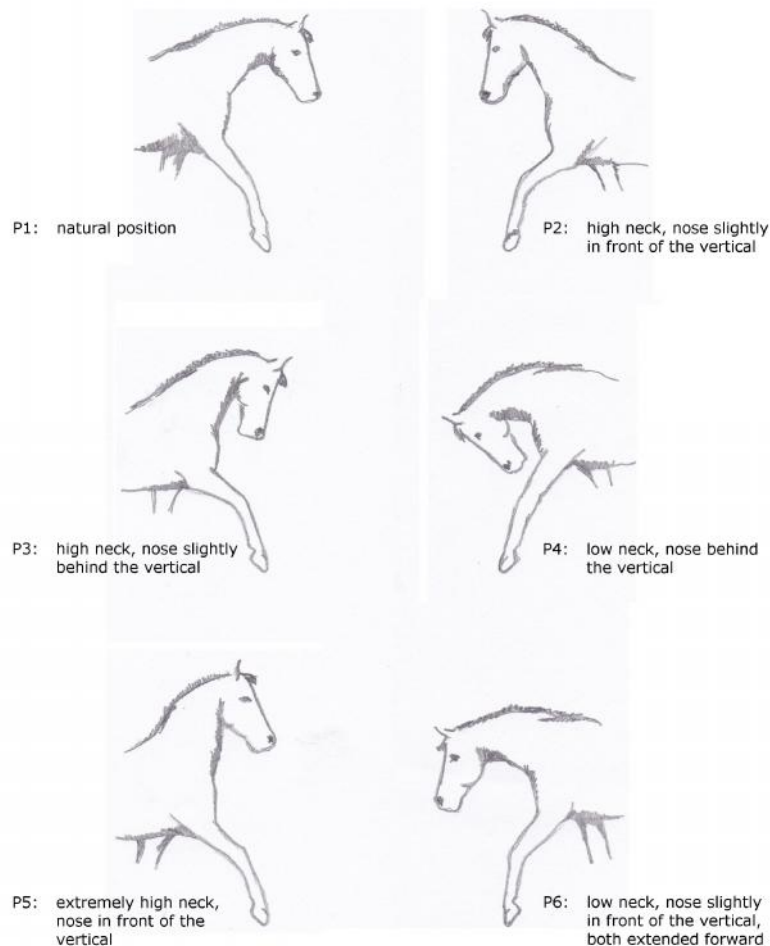


Figure 3: Head and neck positions (P). (Adapted from: Rhodin, 2008)

A research of several different head and neck positions, shown in figure 3, gives a clear picture of the influence on the ROM. An extreme elevation (P5) causes a decrease in ROM of the hind limbs pro- and retraction as well as in flexion and extension of the lumbar back. P2, the second highest neck position also shows similar motion patterns, only the decrease in ROM of pro- / retraction of the hind limbs was not significant at walk. At trot, the three high positions caused a low ROM in the flexion and extension of the thoracic and lumbar back unlike positions 4 and 6, which increased ROM. No significant changes were found in

hind limb ROM, which leads to the conclusion that stride length and back movements are less connected in trot than at walk (Rhodin, 2008).

Comparisons show that the walk is much more sensitive to the different head and neck positions than the trot. This is spelled out through the difference in ground contact. The walk is a four-beat gait and three feet are in contact with the ground at the same time, whereas the trot is a two-beat gait. This leads to a different movement pattern of the thoracolumbar spine and a higher muscular activity to reduce the twist of the back resulting from the diagonal stance phase (Rhodin, 2008).

Rhodin (2008) evaluates the mentioned head and neck positions with a rider in paper IV of the study and confirms the assumption that the different positions result in the same motion patterns with and without a rider.

4.1.3 Basic considerations

As reviewed in chapter 4.1.2 Rhodin (2003; 2008) confirms the fact that there is a relationship between a high head and neck position and a decrease in ROM of flexion and extension of the thoracic and lumbar back as well as reduced pro- and retraction of fore- and hind limbs, whereas a low neck attends an increase in both. Heuschmann (2007 in Rhodin, 2008, p. 41) also determined that a too high head and neck position causes a dropped back.

As described in chapter 3.2.9 collection is gained by an extension or a rise of the back, a lower croup and the bending of the hind limbs (Ettl, 1998). It can therefore be assumed that collection is one of the basic aims to improve a horse's backup. Quickness and controlled speed are results of longer strides and a lifted back. Attitude is also shown by collection.

To analyze the basic assumption that there is a relationship between the head and neck position and the judgment of a reining horse at backup, the author concentrated on Rhodin's (2008) study results for trot. So far no papers interpreting the backup, or rein back, as it is called in dressage, could be found. Like the trot, the correct backup is a two beat, diagonal stepped movement and therefore best comparable in motion.

Knowing that the judges are required to give credit for a fast and smooth backup and Rhodin (2008) having proved that a horse needs to lift its back to move smoothly and round as well as considering that the position of the head and neck has a considerable effect on the back, a relationship between the head and neck position and the judgment of a reining horse at backup is expected. Being part of collection, research also factors into hock angle and the position of the croup to find out if there is a certain body position which helps the horse to 'plus' its backup.

4.2 Reining Worldwide

NRHA has worked on moving the sport of reining to international awareness. 1988 was the first year a NRHA approved show came to Europe. In 2000 the Federation Equestre International approved reining as the first Western discipline at the World Equestrian Games (NRHA, 2013).

Reining originated from the moves a cow horse has to achieve when working cattle and was first admitted as a sport in 1949 by the American Quarter Horse Association. For top performance and the health of reining horses, special grounds and hoof shoes are required. Although representing the spirit of the Wild West, reining becomes more and more popular all over the world. The first FEI World Reining Championship took place during the FEI World Equestrian Games in Spain, 2002, when USA's Shawn W. Flarida became the first World Champion (FEI, 2013).

4.2.1 The Backup

Being one of several reining maneuvers, the backup often seems underestimated and used for schooling only. In training, it helps to keep a horse light on its front hooves, assists in collection through improving the horse's ability to work through its back and can be used to keep the horse focused. Done correctly, the backup is a two-beat, diagonal stepped backward motion without suspension (Dressage Academy, 2008). Figure 4 shows the correct sequence of foot falls: The right hind leg and the front left take the first step, followed by the left hind and the right front.

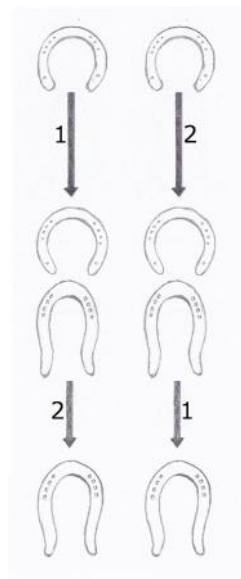


Figure 4: Sequence of steps in the backup.

Although the backup seems to be an easy motion for a horse, there are common mistakes in execution, like being performed as a four-beat movement, not moving in a straight line, showing stiffness in the legs, back or neck, dragging the feet or showing resistance (Dressage Academy, 2008).

4.2.2 Definition of goals in show

As credit should be given for smoothness, finesse, attitude, quickness and authority of performing (NRHA Handbook, 2013), trainer as well as rider have to know the meaning of those terms.

When it comes to riding, smoothness is seen as having an even or gentle motion without abrupt movements, while finesse can be explained by skill and cleverness. This can be shown by adroit maneuvering, for example. Attitude and quickness are produced by a strong, confident, fast motion or impressive quality, but no general understanding could be found for 'authority of performing'.

It is important to know that the backup motion does not provide as many opportunities to raise the maneuver score as other tasks. *"The backup in this case in the reining, is always a result from the run down and the stop"* Jan Boogaerts, an NRHA judge notes in his interview, *"we want a horse to be responsive, [...] and it's not only about whether he drops his head down or not."* (Jan Boogaerts, personal communication, August 31, 2013)

The judgment of a backup is regulated by the AQHA (2013) as described: A backup has to be judged bad, when a horse is resistant and heavy in its shoulder. This can be shown by opening its mouth, raising the head or refusing to back up. An average backup is described as a straight, relaxed movement with only slight rein contact, whereas a good backup is showing a balanced, smooth motion. The horse is willingly moving backwards with almost no contact in the reins.

4.2.3 Methods of training

To find out what the training looks like in reality, different international trainers were questioned about their training by the author, focusing on what they think a judge considers most important when they work on the backup as a single maneuver and how they train their horses' backup.

Terrence Schultz (USA) states that he works on the backup, because many horses could 'plus' the stop maneuver if their backup was better - straight, soft and with speed.

I now teach my horses to back up in the first 30 days under saddle. Then when they start to stop ok I add the backup with the stop. This helps their

stop. When they are strong enough I will back them up 30-50 meters so they know they can do it and I know they can do it. When I show a horse in pattern, such as 10, I may run them 20-30 meters past middle. Just to get a good timed stop I may need this distance. So they have to back up well! (Terrence Schultz, personal communication, October 16, 2013)

Wayne Latimer (World Champion 1978) and Amanda Antifaev (CAN) think that the most important aspect for the judge in a backup is that

the horse is willingly moving backwards, so the horse is not opening its mouth or throwing their head in the air. The horse should be backing up freely, preferably with the chin in, and its neck can be up or down.

(Amanda Antifaev, personal communication, October 26, 2013)

Amanda Antifaev completes:

I work on the backup in connection to maneuvers such as the stop and even for the turn around and circles to get the hind end under them and to pick up shoulders by backing circles. I also make sure to work on the backup as an independent maneuver as well. I pick up my reins evenly and pull until the horse backs up and gives its chin and picks up their shoulders. If they lean one way or the other I will turn the horse around to square up the shoulders and then do it again until they back up a straight line with minimal pressure. Some horses need more help lifting their shoulders in a backup so I may lift my hands higher and bump them in the belly to lift up and / or speed up in the backup. (Amanda Antifaev, personal communication, October 26, 2013)

These trainers are all looking for a 'willing' horse which is soft in its face, but do not seem to concentrate on a certain head position at backup.

4.3 Aims of the empirical study

The objective of this empirical study is to discuss the effect of head and neck positions on the scoring of a reining horse at backup and to find out what international judges concentrate on. Being part of collection, research also factors into hock angle and the position of the croup to find out if there is a certain body position which helps the horse to 'plus' its backup. The knowledge gained by this study should improve training and help non-professional riders to understand training and aims.

5 Materials and methods

5.1 Biomechanical research

5.1.1 Horses

Ten American Quarter Horses between 4 and 8 years of age from Germany, Switzerland, Italy, Great Britain and Austria were used in this study. Table 1 shows a distribution of the horses used in the study. All are privately owned horses in training for competition. Seven of them were able to reach the reining finals at the European Championship of American Quarter Horses in Kreuth 2012.

HORSE NO	SEX	YEAR OF BIRTH	HEIGHT AT WITHERS (CM)	WEIGHT (KG)
1	mare	2007	148	540
2	stallion	2004	150	500
3	gelding	2004	145	455
4	stallion	2006	155	500
5	stallion	2005	152	500
6	stallion	2006	155	480
7	stallion	2008	153	480
8	mare	2007	155	580
9	mare	2005	145	455
10	mare	2008	145	500

Table 1: Distribution of horses included in the study

The riders were asked to use their own equipment, which had to be legal under the AQHA and NRHA show regulations.

5.1.2 Experimental design and protocol

Ten Quarter Horses were studied at backup at their individual preferred speed, defined as a speed at which the horse moves freely and relaxed and shows its best performance. The exhibitors were asked to present their horses as they would do in a show. The horses had to be loped down the middle of the arena, stopped between the last cones and backed up to the first ones as shown in figure 5 below, being examined in three sequencing rounds.

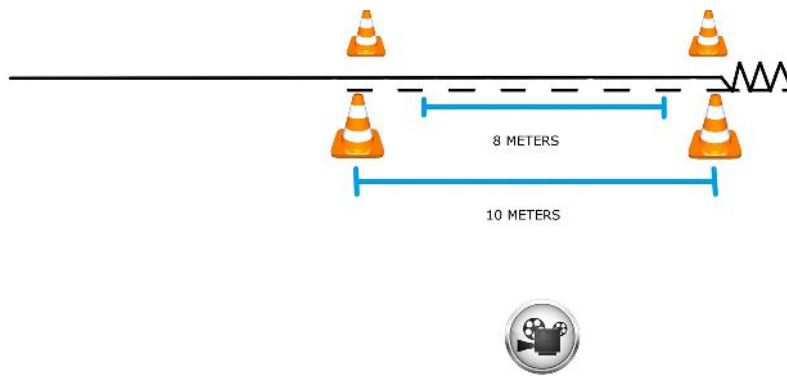


Figure 5: Test instructions

5.1.3 The model

The marker locations, figure 6 and 7, were chosen in accordance to two international trainers, Terrence Schultz (USA) and Steven Hebert (USA/GER), Dr. Christian Peham (Veterinary University of Vienna), as well as referring to commonly used locations for skin marker placement in kinematic analysis shown in Clayton/Schamhardt's (2001) 'Measurement Techniques for Gait Analysis'.

Thirteen spherical skin-fixed markers with a diameter of 50mm were glued onto the skin of 10 Quarter Horses to present anatomical structures such as the four fetlock joints, the first sacral spinous processes and the tail. The remaining parts, were labeled with a white marker of a diameter of 50mm.

There are three different head and neck angles defined for analysis, shown in figure 8. The atlas marker was chosen as the vertex point for the head angle, while the markers in the face and on the shoulder joint define the two legs. The shoulder marker as the vertex point for the neck angle, is calculated to the atlas and the horizontal. The third angle is the calculated total of both, the atlas and the neck angle, and gives information about the so called 'topline' of the horses.

Further angles for analyzing the horses' hind were marked and calculated due to the advice of the international trainers, who both expected a connection between a good backup and a low buttock as well as a distinct flexion of the hock. Croup angle is calculated to the first sacral spinous processes and the horizontal. The tail marker is chosen as the vertex point for this angle. Tuber coxae and the fetlock joint of the right hind leg are used as the two legs for the hock angle.

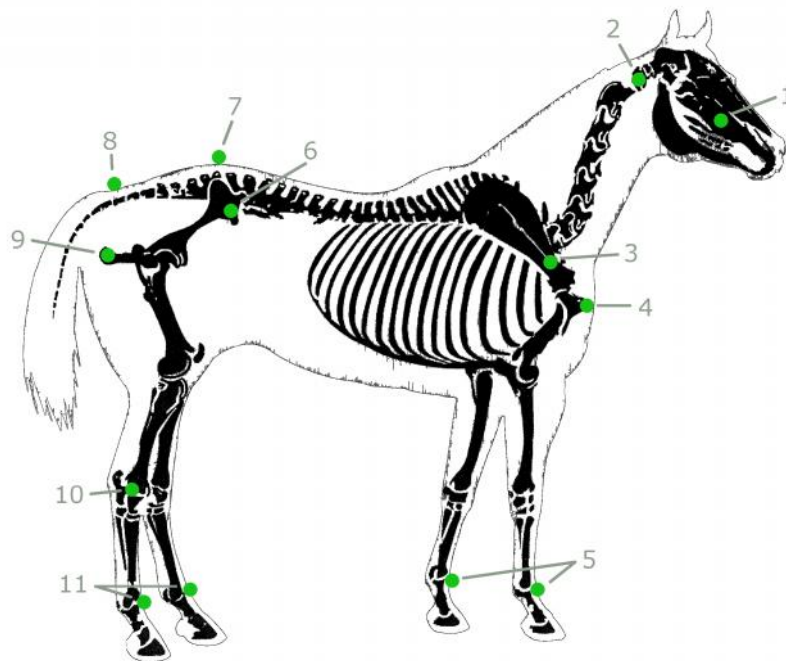


Figure 6: Marker Positions. Illustration: Jörg Brugger

The following positions were used for analysis:

- | | |
|-------------------------------|---------------------------------------|
| 1 Distal part of facial crest | 6 Tuber coxae |
| 2 Atlas | 7 First sacral spinous processes (S1) |
| 3 Scapula | 8 Tail |
| 4 Shoulder joint | 9 Ischium |
| 5 Fetlock joints | 10 Tarsus bone (hock) |



Figure 7: Horse at backup showing marker positions

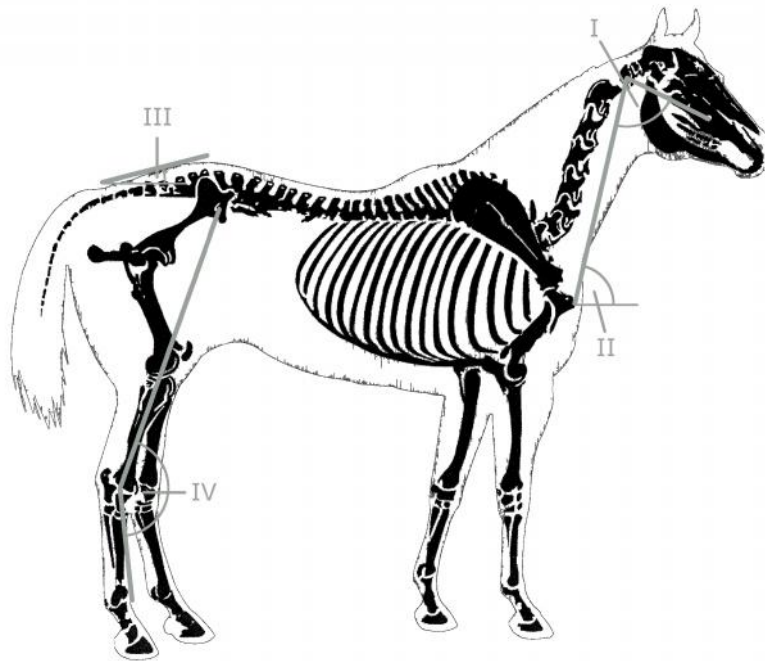


Figure 8: Angles. Illustration Jörg Brugger

These angles were measured in analysis:

I Atlas angle

III Croup angle

II Neck angle

IV Hock angle

5.1.4 Data processing and transformation

Videos were recorded at the European Championship of American Quarter Horses in Germany 2012 and in one big training stable in Austria. A Panasonic hdc-sd99 camera was used and oriented with its axis perpendicular to the area of research. The videos were recorded with 25 frames p/s in the PAL format, each made up of 2 video fields 1/50s apart. This is 50 fields per second (50 hertz). The area was lit by spotlights during recording.

To calibrate this two dimensional study, a rectangular calibration frame was recorded for each horse positioned along the horse's line of progression, measuring a length of 8m and a height of 2.5m as shown in figure 9. Retro reflective markers were used at 0.1m and 2.5m on poles to help tag the grid.



Figure 9: Calibration markers on the grid

5.1.5 Kinematic analysis and smoothing

After the different videos were examined by an international trainer, Terrence Schultz, the best of the three sequencing rounds was chosen for analysis. Drevemo et al. (1980 in Clayton/Schamhardt, 2001, p. 56) suggested that 3-5 strides¹¹ are representative for a motion pattern using kinematic variables. In accordance, three strides were analyzed for each of the horses using SIMI Motion. Start and end for analysis were designated as the moment when the right front hoof touches the ground and the carpus is in full extension. Problems arose when markers were temporarily obscured due to crossing each other during locomotion, therefore interpolation as well as manual digitizing were preferred.

To smoothen data and reduce noise, a moving average filter was used after the digitization process by SIMI motion. According to Smith (2003) it is the most common filter in digital

¹¹ A stride is the movement of all four legs, completed when they return to their initial position.

signal processing and optimal for retaining a sharp step response. The aim is to reduce a certain number of given points into one averaged output signal as the following equation calculating a symmetrical average will show.

$$y[i] = \frac{1}{M} \sum_{j=-(M-1)/2}^{(M-1)/2} x[i+j]$$

where $y []$ is the output signal, $x []$ the input signal and M the number of positions in the average. As a symmetrical average requires an uneven number of position, an example for $M=3$ will be given, describing a three point moving average filter with point 80 in the output.

$$y[80] = \frac{x[79] + x[80] + x[81]}{3}$$

To answer the central questions SIMI Data is exported to Microsoft Excel 2013 and IBM SPSS 16.0 Evaluation Version where temporal as well as angular data are extracted. Values for stride duration, neck angle, atlas angle, head- and topline as well as hock and croup angle are gained. Stride duration is estimated from frame numbers and sampling frequency as the temporal data of 3 strides. Atlas angle is calculated by the displacement of the body segments head and neck, hock angle by the displacement of upper and lower leg, whereas the remaining angles are computed to the horizontal. To do statistical analysis the average data of each angle is referred to.

HORSE	1	2	3	4	5	6	7	8	9	10
TIME	3,56sec	3,16sec	2,56sec	2,76sec	1,96sec	3,44sec	3,08sec	3,16sec	2,80sec	3,20sec
NECK ANGLE										
AV	43°	30°	10°	38°	11°	33°	30°	38°	21°	47°
MIN	37°	23°	0°	28°	6°	24°	16°	35°	16°	37°
MAX	51°	39°	25°	52°	20°	41°	45°	45°	26°	54°
RAN	15°	15°	25°	24°	13°	17°	29°	10°	10°	17°
ATLAS ANGLE										
AV	50°	44°	63°	49°	49°	70°	38°	58°	65°	42°
MIN	47°	38°	59°	40°	47°	55°	30°	54°	61°	33°
MAX	55°	56°	69°	56°	55°	83°	43°	62°	73°	51°
RAN	8°	18°	11°	16°	8°	28°	13°	8°	12°	18°
TOPLINE										
C ANG	93°	74°	73°	86°	61°	103°	68°	97°	86°	88°

TAIL ANGLE										
AV	27°	25°	33°	27°	34°	22°	25°	33°	31°	30°
MIN	24°	22°	28°	23°	29°	18°	20°	29°	26°	26°
MAX	33°	30°	39°	30°	38°	28°	29°	38°	35°	34°
RAN	9°	8°	11°	7°	8°	10°	9°	9°	8°	8°
HOCK ANGLE										
AV	135°	130°	124°	128°	124°	135°	131°	127°	126°	136°
MIN	121°	117°	98°	113°	109°	124°	113°	116°	113°	119°
MAX	142°	139°	136°	136°	134°	146°	144°	135°	135°	149°
RAN	21°	21°	38°	23°	25°	22°	31°	19°	22°	30°

Table 2: Average of angular and temporal data

5.2 Qualitative Analysis

To be able to compare the judgment in section 6.1 to the horses' movements, Judges were asked to score the backup like any maneuver in a show (NRHA Handbook, 2013, p. 167):

- 1½ Extremely Poor
- 1 Very Poor
- ½ Poor
- 0 Correct
- +½ Good
- +1 Very Good
- +1½ Excellent

As the backup belongs to a whole maneuver group and the Judges were only shown part of this group, they changed to the following scale of judging:

Grade	Assessment	influence on the maneuver score
1	excellent	raise
2	good	raise in doubt
3	correct	no influence
4	below average	drop in doubt
5	poor	drop

Table 3: Judgment scale for backup

In addition, each of the Judges gave a short comment on the judged backup, presenting his/her considerations on the scored maneuver.

To limit subjectivity, the three international Judges, Jan Boogaerts (BEL), Hannes Gaube (AUT) and Sari Hébert Kurkijärvi (FIN/CH) were questioned separately. Each of them holds either an AQHA or an NRHA judges card. Their analysis were compared to the different marker positions and angles, obtained after smoothing SIMI data.

5.3 Statistical Analysis

The statistical analysis were done using Microsoft Excel 2013 (Washington, United States) and IBM SPSS 16.0 Evaluation Version (New York, United States).

5.3.1 Rank-order and Product-Moment correlation

As ordinal data was used in Judges' ranking to evaluate the horses' movements, the Spearman's rank-order correlation was used to interpret kinematics. Spearman's correlation coefficient (ρ) measures the strength of association between two ranked variables and recognizes the assumption of a monotonic relationship (Laerd Statistics, 2013).

Values from +1 to -1 can be found for the Spearman correlation coefficient (ρ). +1 shows a perfect match of ranks, while a ρ of zero would indicate no connection at all. It is important to be aware that the Spearman correlation does not explain the strength of the relationship though (Laerd Statistics, 2013).

To confirm suspicions, the following null hypothesis are looked at:

H_0 : There is no association between judgment and the duration for three strides.

H_0 : There is no association between judgment and the average neck angle.

H_0 : There is no association between judgment and the average atlas angle.

H_0 : There is no association between judgment and the average topline.

H_0 : There is no association between judgment and the average hock angle.

H_0 : There is no association between judgment and the average tail angle.

To estimate the association between the examined data, Medistat (2013) suggests the following scale:

$0.0 \leq \rho \leq 0.2 \Rightarrow$ no till slight connection

$0.2 < \rho \leq 0.5 \Rightarrow$ weak till moderate connection

$0.5 < \rho \leq 0.8 \Rightarrow$ clear connection

$0.8 < \rho \leq 1.0 \Rightarrow$ high till perfect connection

With setting $\alpha = 0.05$, there is less than a 5% chance that the strength of the relationship happens incidentally.

The leave-one-out cross validation is used for recalculating and confirming the reliability of the measured data.

To look for connections between the different values taken for analyses, like stride duration, atlas angle, neck angle, topline, et cetera, Pearson correlation is used. The Pearson product-moment correlation (r) measures the strength of a linear connection by defining the distance of data to the line of best fit (Laerd Statistics, 2013).

6 Results

6.1 Judges Analysis

Using the following scale, grades were given for each backup:

HORSE	JUDGE A	JUDGE B	JUDGE C	GRADE	ASSESSMENT	INFLUENCE ON THE MANEUVER SCORE
1	3	3	4	1	excellent	raise
2	4	5	5	2	good	raise in doubt
3	2	2	1	3	correct	no influence
4	2	3	3	4	below average	drop in doubt
5	1	3	2	5	poor	drop
6	5	5	5			
7	5	5	4			
8	4	3	5			
9	3	3	4			
10	3	4	3			

Table 4: Ordinal evaluation

Horse number 1, shown in figure 10, shows a steady and balanced backup with an average score of 3.3, which is an average rating.



Figure 10: Horse no.1

Mentioned as positive by Judge A is that the shoulder stays up and the horse is responding to the bridle, but the back could be rounder bringing weight to the hind end. Judge B mentions that the neck is carried too high for the back to be round.

The second horse is resistant in the beginning and has therefore scored an average of 4.7.



Figure 11: Horse no. 2

Judge A's analysis is that the horse shown in figure 11 does not have its rib cage and its shoulder up, which makes it more 'draggy', while Judge B explains that the tail shows protest to the rein and the spurs.

With an average score of 1.7, horse number 3, shown in figure 12, is performing best.



Figure 12: Horse no. 3

This horse is showing a round back and a balanced, smooth motion, while being responsive. Although the first two steps are a little bit crossed all Judges agreed on this assessment.

Horse number 4 is shown in figure 13 and does a fluent, willing backup graded 2.7.



Figure 13: Horse no. 4

Judge A likes the horse being really round when going into the backup maneuver, ignoring that the head is a little higher. This fact brings more weight on the horses' hind quarters, Judge B agrees.

Controversial judgment on horse number 5, shown in figure 14, leads to a scoring of 2.0.



Figure 14: Horse no. 5

This horse is really responsive to the hand, really soft in its mouth, keeps its shoulders up and has good speed, which raises the level of difficulty. This is an excellent backup, Judge A explains. Judge B perceives this maneuver as enforced and scores average.

Horse number 6 is scored poorly by all Judges.



Figure 15: Horse no. 6

The Judges agree that the horse shown in figure 15 is 'draggy' and shows a lot of protest. Judge A explains: "[...] he's got what we say [...] 'his hind feet in his tail', which means he's totally not collected."

Horse number 7 only gains a score of 4.7, showing a lot of resistance.



Figure 16: Horse no. 7

The horse shown in figure 16 is draggy and is being pulled back on the reins. The Judges agreed that it does not keep its rib cage up nor puts its weight on its hind quarters.

Horse number 8 is controversial with the Judges again and scored an average of 4.0.



Figure 17: Horse no. 8

The topline is changing a lot in the horse shown in figure 17, which means, it brings its neck up and down, Judge A explains. Judge B sees a willing backup with only slight rein contact.

Horse number 9, shown in figure 18, does a correct maneuver, being scored with 3.3.



Figure 18: Horse no. 9

The Judges agree on a willing, smooth backup with a round back. Nothing is offensive here, but there is no degree of difficulty either.

Horse number 10, shown in figure 19, is also judged 3.3.



Figure 19: Horse no. 10

The neck is a little bit high on this horse which is why its back is not round enough in the maneuver, Judge B exemplifies. This horse gets its hind foot in its tail, showing that it does not have its hind feet underneath its body. *"This is a correct backup, just not really athletic"*, Judge B explains.

6.2 Kinematic Analysis

Using the Excel data, which was shown in table 2, atlas angle is compared in figure 20, showing the two horses judged best (horse no 3 with an average of 1.7 and horse no 5 with an average score of 2) as well as the horse which was scored weakest performance (horse no 6 with an average of 5).

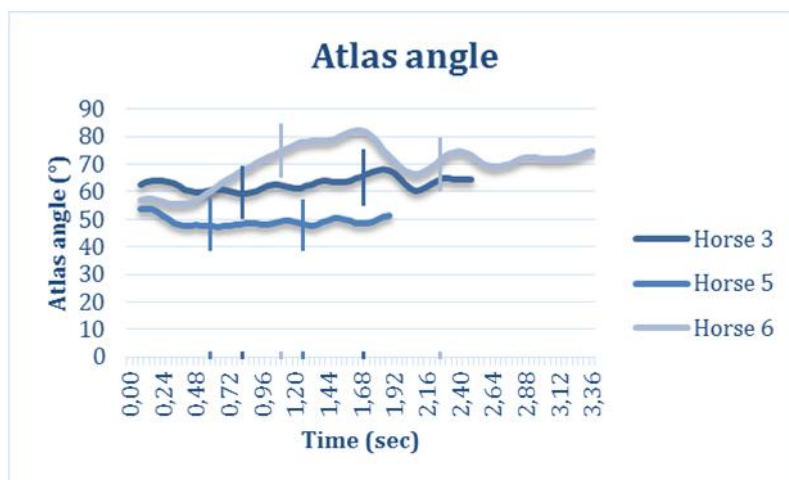


Figure 20: Smoothed atlas angles in comparison over 3 strides

A clear difference in angle can be detected with the weaker horse showing a high range in its movement (28°). The different strides of each horse are marked by vertical lines.

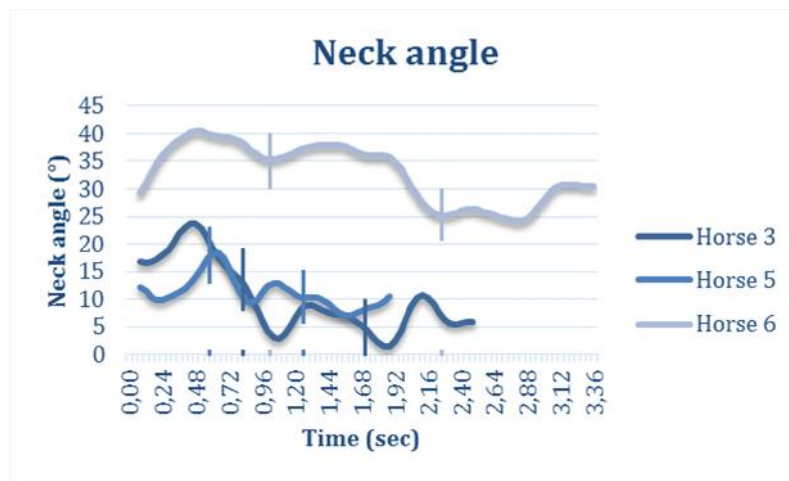


Figure 21: Smoothed neck angles in comparison over 3 strides

The difference is a lot more obvious in the graphic analysis of the neck angle, figure 21, where the same horses, see Atlas angle figure 20, are compared. The neck angle is decreasing in all of the horses over the 3 strides, but no general movement pattern can be analyzed when looking at the different strides.

6.3 Statistical Analysis

6.3.1 Spearman correlation

Spearman's rho is calculated using SPSS:

Correlations			Judge A	Judge B	Judge C	Scoring	Duration
Spearman's rho	Judge A	Correlation Coefficient	1,000	,770**	,838**	,962**	,640*
		Sig. (2-tailed)	.	,009	,002	,000	,046
		N	10	10	10	10	10
	Judge B	Correlation Coefficient	,770**	1,000	,607	,859**	,500
		Sig. (2-tailed)	,009	.	,063	,001	,141
		N	10	10	10	10	10
	Judge C	Correlation Coefficient	,838**	,607	1,000	,899**	,650*
		Sig. (2-tailed)	,002	,063	.	,000	,042
		N	10	10	10	10	10
	Scoring	Correlation Coefficient	,962**	,859**	,899**	1,000	,664*
		Sig. (2-tailed)	,000	,001	,000	.	,036
		N	10	10	10	10	10
	Duration	Correlation Coefficient	,640*	,500	,650*	,664*	1,000
		Sig. (2-tailed)	,046	,141	,042	,036	.
		N	10	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 22: Spearman's rho for step duration

Significant correlation at the 0.05 level with a significance of 0.036 could be found between all three Judges and step frequencies with a ρ of 0.664 indicating a clear connection. H_0 has to be rejected. H_1 saying that there is an association between judgment and backup stride duration is valid. The higher the frequency of a horse at backup, the better the judgment. Looking separately at the different scorings displayed in figure 22 there is a lack of significance with Judge B.

Using figure 22 to evaluate the match on the different judgments, correlation of $\rho = 0.770$ and $\rho = 0.838$ is found for Judge A and B as well as A and C at a significance level of 0.01 while no significance is found between Judges B and C, getting a significance of 0.063 although a ρ of 0.607 would show clear connection.

Correlations						
			Judge A	Judge B	Judge C	Scoring
Spearman's rho	Atlasangle	Correlation Coefficient	-,028	-,401	,166	-,049
		Sig. (2-tailed)	,939	,251	,647	,892
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 23: Spearman's rho for atlas angle

No agreement could be found for judgment and atlas angle proved in figure 23. With $\rho = -0.028$ (Judge A), $\rho = -0.401$ (Judge B) and $\rho = 0.166$ (Judge C) there is no connection with either Judge, H_0 is not rejected here.

The same picture occurs when looking for a connection between the scoring of all three Judges and neck angle as shown in figure 24.

Correlations						
			Judge A	Judge B	Judge C	Scoring
Spearman's rho	Neckangle	Correlation Coefficient	,255	,257	,310	,297
		Sig. (2-tailed)	,476	,473	,383	,404
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 24: Spearman's rho for neck angle

No significant connection is found for the Judges' assessment and the neck angle as well as the topline, figure 25, which is calculated from atlas and neck angle. So H_0 is also valid for judgment and neck angle.

Correlations						
			Judge A	Judge B	Judge C	Scoring
Spearman's rho	Topline	Correlation Coefficient	,419	,125	,578	,438
		Sig. (2-tailed)	,228	,731	,080	,205
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

Figure 25: Spearman's rho for topline

Correlations						
			Judge A	Judge B	Judge C	Scoring
Spearman's rho	Tailangle	Correlation Coefficient	-,709*	-,794**	-,569	-,758*
		Sig. (2-tailed)	,022	,006	,086	,011
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 26: Spearman's rho for tail angle

Correlation is found in Spearman's rho for judgment and tail angle though. As shown in figure 26 $\rho = -0.758$ with a significance of 0.011, indicating a clear, indirect connection. Looking at the Judges separately, there is no significance for the scoring of Judge C.

H_0 has to be rejected here and H_1 , saying that there is an association between judgment and tail angle, is valid. As ρ is negative, the indirect relation implies that a better, meaning a lower grade, complies with a larger tail angle referring to a steep-sided croup.

Hock angle only shows significance with Judge B, shown in figure 27. No association was found for the general judgment and H_0 has to be kept.

Correlations						
			Judge A	Judge B	Judge C	Scoring
Spearman's rho	Hockangle	Correlation Coefficient	,561	,666*	,401	,594
		Sig. (2-tailed)	,092	,035	,250	,070
		N	10	10	10	10

**. Correlation is significant at the 0.01 level (2-tailed).

*. Correlation is significant at the 0.05 level (2-tailed).

Figure 27: Spearman's rho for hock angle

6.3.2 Leave-one-out cross-validation

As Spearman's correlation does not show the expected association between head and neck position and the judgment, further analysis is done to confirm the results. To do so, leave-one-out cross-validation is used and data is analyzed with competitor dropping one set of data for its final calculation.

Table 5 shows Spearman's rho when removing one horse after each other. For example the initial correlation coefficient for scoring and stride duration is $\rho = 0.66$. When dropping horse number 1 in this calculation, a ρ of 0.81 is obtained. Marked in grey, big changes in Spearman's rho can be identified. As horse number 7 shows three substandard correlations, data was examined for significance scratching this horse's data set for recalculation, displayed in figure 28.

		REMOVING HORSE NO									
	ρ	1	2	3	4	5	6	7	8	9	10
SC / DU*	0,66	0,81	0,71	0,55	0,53	0,55	0,62	0,72	0,72	0,61	0,74
SC / CA*	0,44	0,45	0,58	0,37	0,44	0,26	0,22	0,70	0,43	0,46	0,45
SC / NA*	0,30	0,39	0,37	0,03	0,41	0,03	0,37	0,37	0,39	0,21	0,39
SC / AA*	-0,05	-0,06	0,09	0,09	-0,05	-0,05	-0,45	0,15	-0,08	-0,09	-0,04
SC / TA*	-0,76	-0,79	-0,67	-0,73	-0,82	-0,69	-0,66	-0,67	-0,88	-0,80	-0,80
SC / HA*	0,59	0,71	0,61	0,45	0,54	0,45	0,56	0,61	0,67	0,57	0,75

* correlation between scoring and duration / combined angle / neck angle / atlas angle / tail angle / hock angle

Table 5: Leave-one-out test

			Correlations						
			Scoring	Duration	Atlas angle	Neck angle	Topline	Tail angle	Hock angle
Spearman's rho	Scoring	Correlation Coefficient	1,000	,723'	,145	,374	,698'	-,667'	,607
		Sig. (2-tailed)	.	,028	,710	,321	,037	,050	,083
		N	9	9	9	9	9	9	9
	Duration	Correlation Coefficient	,723'	1,000	,050	,727'	,824''	-,671'	,878''
		Sig. (2-tailed)	,028	.	,898	,027	,006	,048	,002
		N	9	9	9	9	9	9	9
	Atlas angle	Correlation Coefficient	,145	,050	1,000	-,391	,340	-,004	-,300
		Sig. (2-tailed)	,710	,898	.	,298	,370	,991	,434
		N	9	9	9	9	9	9	9
	Neck angle	Correlation Coefficient	,374	,727'	-,391	1,000	,685'	-,405	,835''
		Sig. (2-tailed)	,321	,027	,298	.	,042	,279	,005
		N	9	9	9	9	9	9	9
	Topline	Correlation Coefficient	,698'	,824''	,340	,685'	1,000	-,485	,667'
		Sig. (2-tailed)	,037	,006	,370	,042	.	,185	,050
		N	9	9	9	9	9	9	9
	Tail angle	Correlation Coefficient	-,667'	-,671'	-,004	-,405	-,485	1,000	-,746'
		Sig. (2-tailed)	,050	,048	,991	,279	,185	.	,021
		N	9	9	9	9	9	9	9
	Hock angle	Correlation Coefficient	,607	,878''	-,300	,835''	,667'	-,746'	1,000
		Sig. (2-tailed)	,083	,002	,434	,005	,050	,021	.
		N	9	9	9	9	9	9	9

*. Correlation is significant at the 0.05 level (2-tailed).
 **. Correlation is significant at the 0.01 level (2-tailed).

Figure 28: Spearman's rho without horse no. 7

Clear influence on the correlation to the front angles as well as the correlation to stride duration can be detected due to an increase in Spearman's rho as well as better significance. Concerning atlas and neck angle, H_0 is still valid, but analyzing the topline, Spearman's rho rises from $\rho = 0.438$ with a significance of 0.205 to a significant ρ of 0.698. This leads to the conclusion, that the topline, calculated from atlas and neck angle, is a significant indicator for good judgment.

6.3.3 Pearson correlation

To analyze whether there is a correlation between any of the ascertained values, Pearson product-moment correlation is used to detect the following connections:

H_0 : There is no association between any of the following values: backup duration, atlas angle, neck angle, topline, tail angle or hock angle.

Before using Pearson correlation the data has to be tested of 'normality' displayed in figure 29.

H_0 : There is no difference between normality and the following data.

Tests of Normality						
	Kolmogorov-Smirnov ^a			Shapiro-Wilk		
	Statistic	df	Sig.	Statistic	df	Sig.
Duration	,195	10	,200 [*]	,925	10	,403
Atlas angle	,203	10	,200 [*]	,946	10	,618
Neck angle	,197	10	,200 [*]	,927	10	,421
Topline	,191	10	,200 [*]	,965	10	,839
Tail angle	,161	10	,200 [*]	,934	10	,492
Hock angle	,182	10	,200 [*]	,907	10	,262

a. Lilliefors Significance Correction

*. This is a lower bound of the true significance.

Figure 29: Tests of Normality

As significance is at 0.2, H_0 has to be kept and the Pearson correlation can be used.

Correlations							
		Duration	Atlas angle	Neck angle	Topline	Tail angle	Hock angle
Duration	Pearson Correlation	1	,000	,785**	,723 [*]	-,657 [*]	,827**
	Sig. (2-tailed)		,999	,007	,018	,039	,003
	N	10	10	10	10	10	10
Atlas angle	Pearson Correlation	,000	1	-,329	,497	,111	-,235
	Sig. (2-tailed)	,999		,354	,144	,761	,513
	N	10	10	10	10	10	10
Neck angle	Pearson Correlation	,785**	-,329	1	,655 [*]	-,445	,797**
	Sig. (2-tailed)	,007	,354		,040	,197	,006
	N	10	10	10	10	10	10
Topline	Pearson Correlation	,723 [*]	,497	,655 [*]	1	-,310	,538
	Sig. (2-tailed)	,018	,144	,040		,383	,108
	N	10	10	10	10	10	10
Tail angle	Pearson Correlation	-,657 [*]	,111	-,445	-,310	1	-,683 [*]
	Sig. (2-tailed)	,039	,761	,197	,383		,030
	N	10	10	10	10	10	10
Hock angle	Pearson Correlation	,827**	-,235	,797**	,538	-,683 [*]	1
	Sig. (2-tailed)	,003	,513	,006	,108	,030	
	N	10	10	10	10	10	10

** . Correlation is significant at the 0.01 level (2-tailed).

* . Correlation is significant at the 0.05 level (2-tailed).

Figure 30: Product-moment correlation

Shown in figure 30, significant correlation can be found for duration and neck angle ($r=0.758$, $R^2=62\%$), combined angles ($r=0.723$, $R^2=52\%$), tail angle ($r=-0.657$, $R^2=43\%$) and hock angle ($r=0.827$, $R^2=68\%$), for neck and hock angle ($r=0.797$, $R^2=64\%$) as well as for tail and hock angle ($r=-0.683$, $R^2=47\%$). This leads to the conclusion that the backup duration or step frequency is a result of an optimal body position. The linear correlation is shown in the following figures.

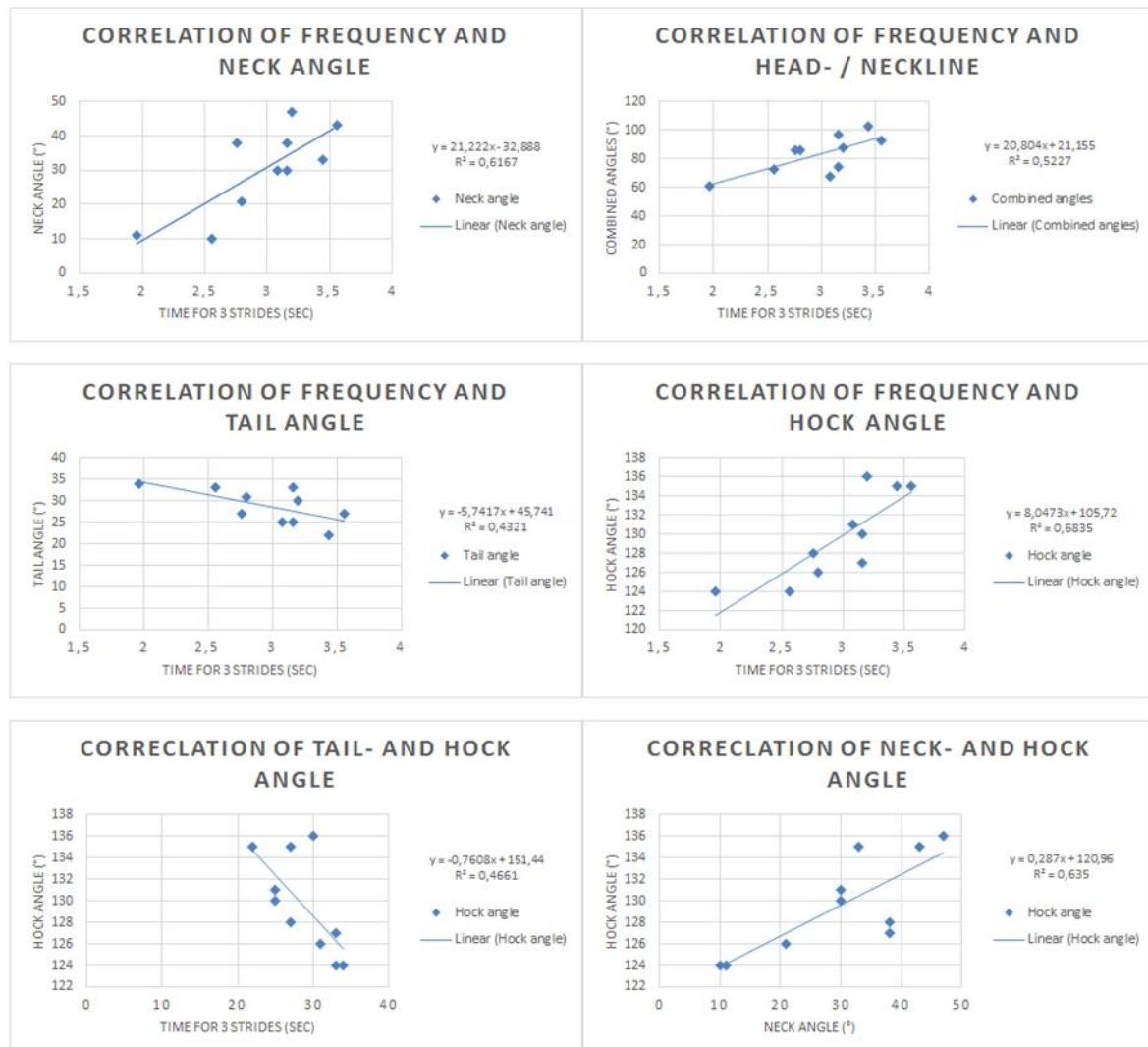


Figure 31: Linear correlation between the significant values

7 Discussion and conclusions

7.1 Limitations in research

7.1.1 Research methods

To get valid results research horses have to reflect the population on which the results should be applied to. All Quarter Horses used in this study are active show horses. This, of course, reduces the possibilities of research to non-invasive, harmless alternatives as most of the videos were done at the European Championships with horses participating.

In addition, it is not possible to analyze a backup maneuver without a rider, as these horses are not trained to do so and different motion patterns would occur. Therefore only the caudal back, hock angle as well as backup duration or step frequency could be studied and former findings, described in chapter 4.1.2, had to be used to verify the connection between the ROM both of the hind limb pro- and retraction and the thoracic and lumbar back flexion-extension.

7.1.2 Skin displacement

For analyzing horses movements a number of skin fixed markers were used. More difficult positions were labeled with white marker points. Precedent studies have shown that skin displacement related positional changes may occurred when using non-invasive methods. These limitations must be thought of when comparing the different angles (Rhodin, 2008).

7.1.3 Observer based gait analysis

Experienced Judges determine the outcome of different sports, reining amongst others. It is therefore valid to use judging to rate horses' motion. The limitation of subjectivity of gait analysis based on an observer has to be deliberated (Clayton/Schamhardt, 2001).

7.2 Discussion

The outcome of this study shows that there is a significant connection between the scoring of the three Judges, but taking a closer look, big differences in some horses' judgment can be found. Horse no. 5 for example, is given a 1, a 2 and a 3, which means that one and the same horse is judged excellent by one Judge and 'only' correct by another. The explanations the Judges gave in their interviews show, that some of them just don't like the horses' head being behind the vertical, which is reason to a worse scoring. The author was

not able to find any regulation in the rulebooks concerning the position of the horses' head during backup.

A significant correlation to the topline was only found after excluding horse number 7. To the author's opinion, the body position of this horse was enforced by its rider. As this horse was really 'bracy', the rider had to 'pull it back', which influenced the head and neck position. With an average atlas angle of 38° this angle was the smallest measured. The high range of 29° between the minimal and maximal neck angle provides evidence of the fact that the horse was resistant and did not 'give its back', resulting in a poor score although head and neck were low.

The result of this study is in contrast to the author's expectations, detecting no connection between the head and neck position and the scoring at backup. Knowing that the stride length is significantly longer when the neck is carried low (Rhodin, 2013), long strides were expected to result in a fast backup. As credit is given for quickness in the manœuvre, this fact was seen as one important aspect for good judgment. A reason for the falsification of this hypothesis is found in the correlation of judgment and stride duration. This leads to the idea, that not the length but the duration of a stride is important to a good backup. That means that shorter steps with a higher frequency are scored better, although the resulting speed may be equal.

7.3 Conclusion

To the authors knowledge this was the first study to evaluate a backup movement of a ridden horse. It was found that there is no significant relationship between the head and neck position and the judgment of a reining horse at backup. It can therefore be concluded that neither the head nor the neck position is reason to a good scoring by itself. After excluding one set of data due to the leave-one-out cross-validation test, Spearman's rho for judgment and topline rose to a significant correlation coefficient of 0.698, indicating a clear connection. The topline is generated by summing up atlas and neck angle. A low topline angle of atlas and neck significantly reduced the grade, meaning better judgment.

The findings in this study were borne by three international Judges. Their judgment was also tested for correlation to avoid mistakes. Clear connection was found for all of them.

When searching for further correlations with scoring detecting easier ways of experiencing whether a backup is good or not, an indirect connection was found for the tail angle. This relation implies that a better, meaning a lower grade, complies with a larger tail angle referring to a steep-sided croup.

The neck angle does not have an influence on the judgment, but an association with stride duration was detected. Therefore data sets were tested for correlation among one another, finding clear association between stride duration and most of the other records. Significance was found for neck angle, topline, tail angle and hock angle, which leads to the assumption that a short stride duration and therefore a high frequency is a result of an optimal body position at backup and found to be the best indicator for judgment. Referring to Pearson's correlation of the aforementioned, the conclusion can be made that perfect play of angles leads to a high maneuver score. Horses with deficits in one of the parameters have to accentuate in the remaining joint positions.

Example given: horse 9 and 10. Both achieved the same score, although big differences were found in their atlas and neck angles. Equal croup angles and an almost concurring combined angles were analyzed. While horse no. 9 showed an average atlas angle of 65° with a neck angle of 21° , horse no. 10 moved at an highly contrasting average atlas angle of 42° and a neck angle of 47° . This contrast in both angles, lead to equalization of the combined angle and results in the same judgment for both horses.

As several correlations were found between the tested sets of data, like significant associations between neck and hock and between tail and hock angle, this leads to the conclusion that judgment cannot be predicted by one or two independent angles, and can only be seen as the result of a combination of several optimal angles. Stride duration or step frequency is one parameter which results from a good body position and is one possibility to analyze a backup.

Glossary of terms

AQHA	17
aids	20
Backup	9, 20, 28
cantle	11
collection	20, 27
cow sense	12
cues	20
curb bit	11
cutting	16
halter	15
(western) horsemanship	16
NRHA	17, 21, 28
Pearson product-moment correlation	41, 52
poll	12
pommel	11
(western) pleasure	13, 15
reining	16, 17, 21, 28
reining pattern	16, 17, 18, 19, 21, 24
resistance	20, 21
run down	19
showmanship	15
sliding stop	19
smoothness	9, 21, 29
Spearman's rho	40, 48
straightness	20
stride	37
trail	16
weanling	15
western riding (discipline)	16
working cowhorse	16, 17

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Appendix

Abbreviations

AQHA Austrian Quarter Horse Association

FEI Fédération Equestre Internationale

GNEF German National Equestrian federation

No. number

NRHA National Reining Horse Association

P1-6 head and neck position

ROM Range of motion

Email - Interviews

The questioned trainers were asked to answer the following questions:

- ❖ What do you think is the most important aspect for a Judge when scoring a backup (except for backing up in a straight line the required distance)? What will help the maneuver?
- ❖ Do you work on the backup as a single maneuver when you train your horses?
- ❖ How do you work on the backup? What do you look for in your horses? Is it the same strategy for all your training horses?

Terrence Schultz (USA)

Howdy!

Yes I work on it. Many horses could plus the stop maneuver if their backup was better. Straight, soft, with speed.

I now teach my horses to back up in the first 30 days under saddle. Then when they start to stop ok I add the backup with the stop. This helps their stop. When they are strong enough I will back them up 30-50 meters so they know they can do it and I know they can do it. When I show a horse in pattern, such as 10, I may run them 20-30 meters past middle. Just to get a good timed stop I may need this distance. So they have to back up well!

And yes it is the same for all horses. Some are just better than others.

I hope it helps,

Terry

Wayne Latimer, Amanda Antifaev (CAN)

Hi Alexandra,

I think the most important aspect for the judge in a backup is that the horse is willingly moving backwards, so the horse is not opening its mouth or throwing their head in the air. The horse should be backing up freely preferably with the chin in, neck can be up or down.

I work on the back up in connection to maneuvers such as the stop and even for the turn around and circles to get the hind end under them and to pick up shoulders by backing circles. I also make sure to work on the back up as an independent maneuver as well. I pick up my reins evenly and pull until the horse backs up and gives its chin and picks up their

shoulders. If they lean one way or the other I will turn the horse around to square up the shoulders and then do it again until they back a straight line with minimal pressure. Some horses need more help lifting their shoulders in a backup so I may lift my hands higher and bump them in the belly to lift up and or speed up in the back up.

I hope that helps,

Amanda

Scoring

Judge A

Judge A was shown the videos and asked for an oral judgement.

Horse no. 1

#00:00:02-4# so

#00:00:09-3# see

#00:00:18-7# now the backup in this case in the reining is always a result from the run down and the stop

#00:00:27-3# what I do like here is that the shoulder stays up and he, the horse is giving to the bridle

#00:00:35-3# the only thing is to have an even better backup I would love to see him round up little more in the back and get a little bit more weight on his hind end but after all that's the reason why we back up the horses to get more weight on the hind end

#00:00:51-9# so to me this is an ok back up and it's straight and there is no resistance in the horse

#00:01:00-2# so if I get say like a plus half stop it will not help the stop but it will not hurt the stop either

Horse no. 2

#00:00:01-6# now this one

#00:00:05-5# I like the stop a little bit. I like it how the horse is gettin' soft. now here the horse is in the beginning of the backup is a little bracy.

#00:00:14-2# now is a little bracy in the neck, little bracy in the face. To me it's kind of like the same as the previous one but if I'm on the bubble

#00:00:22-5# like the run down and the run around, the run down and the stop and I'm thinking naaa zero plus half

#00:00:29-1# you know if he is on the bubble - with the resistance he has in the beginning of the backup, this might bring him in the zero zone instead of helping him in the plus half zone

#00:00:40-7# but again I mean the previous horse had his shoulder a little bit more up. This one because he is so bracy doesn't have his rib cage and his shoulder up which makes it more like a draggy backup anyway

Horse no. 3

#00:00:00-0# and then here on the third one. See this horse is way more round going in. It's pretty round in the stop

#00:00:08-3# and look how he dropped off that bridle. To me this is like a really nice backup. You see how he rounds up, his rib cage is up his hind end is underneath him, he is responsive.

#00:00:21-0# the first two steps, I think he was going a little bit cross on him

#00:00:25-6# and then he straightens out. So to me this is a good backup

#00:00:29-1# while the previous two were more towards the average, this back up is gonna help him in his maneuver. I think this is a good backup

Horse no. 4

#00:00:00-0# This goes in really rounded.

#00:00:03-1# Drops off the bridle really easy.

#00:00:06-2# So far I would say this is the back... the best backup of the four.

#00:00:10-3# See and it's not about whether he drops his head down or not.

#00:00:14-4# We wanna horse to be responsive, just like the a general say, you know.

#00:00:19-4# Every, every movement we're thinking about 'a general' like a... to reign a horse not only to guide him, to control every movement. The best trained horse should be willingly guided and be dictated to completely.

#00:00:32-0# Ahm, any movement on his own must be considered a lack of control

#00:00:35-1# and then credit should be given for smoothness, finesse, attitude and authority in performing the various maneuvers, while using controlled speed which raises the difficulty level and makes it more pleasing to watch to an audience.

#00:00:48-5# That fourth stop there, or backup that was by far to me, the one that - in composes what 'a general' says.

Horse no. 5

#00:00:00-0# see

#00:00:02-8# and if you play it, this is probable a real live speed?

#00:00:08-7# if I look at it like that, as a matter of fact, it's an excellent backup

#00:00:15-1# this is an excellent backup!

#00:00:18-6# horse is really soft, rounding out, keeping its shoulders up,

#00:00:23-1# you know most of its way over its hand and very responsive, good speed on it, which raises the difficulty level

#00:00:32-6# even if I am thinking zero, on the run around, the run down and the stop, with this back up I may jump it up easy to a plus half maneuver

#00:00:44-3# and you got to be aware it's not just the stop, it's not just the roll back, it's not just the back up, it's the whole maneuver. Being the run around, the run down the stop itself... And what comes next?

Horse no. 6

#00:00:00-8# now this one is real draggy and there is a lot of protest in the horse. See? It doesn't wanna be responsive in the mouth

#00:00:09-5# and every time you see the rider like suggests for him to do more, he just says 'no I don't'. Apart from the end out there

#00:00:19-0# This horse is bracy. Now it doesn't have his back and its rib cage up, there is a lot of protest in it

#00:00:26-2# as a matter of fact he's got what we say he's got his hand feed in his tail

#00:00:32-6# which means he's totally not collected. Certainly not compared to the previous horse

#00:00:37-8# so this to me is a poor back up

Horse no. 7

#00:00:06-9# see this is real draggy, this is gonna hurt his maneuver

#00:00:11-3# If I'm thinking zero and everything else and I see this, this to me brings it back to a minus half because, see he is responsive but everywhere else he's draggy you know

#00:00:25-4# he doesn't put all his weight on his hand and he doesn't keep his ribcage up and it's like 'yes I'm doing it cause you pull on me, but I'd rather not'.

Horse no. 8

#00:00:02-3# this one goes in the ...

#00:00:10-6# to me it's not really a poor backup, but it's not a good backup either

#00:00:17-3# it's a little bit below average

#00:00:21-2# It's draggy, it's bracy

#00:00:25-8# you see that topline is going like he brings his neck up, he brings his neck down, he levels out, he does all kinds of weird things

#00:00:32-6# so to me this is, I'm not saying poor but for me it's definitely below average

#00:00:38-8# like if it's a solid plus half maneuver, with that backup I can live with it, but it better be a solid plus half maneuver

Horse no. 9

#00:00:01-8# this to me is average

#00:00:06-8# he doesn't do anything wrong, he does what is asked for and expected. But it's not like he's giving his heart, you know what I'm saying

#00:00:16-7# It's an average backup, but you know, he's rounded out nicely, things can be way better but nothing is offending me in this maneuver

Horse no. 10

#00:00:02-9# so he had to reline, 'cause half of that stop he was a little bit cricked

#00:00:07-8# he relines all right but see how he always gets that hind foot in that tail?

#00:00:14-3# that means he doesn't have his hind feet underneath his body

#00:00:18-4# and he can only have his hind feet underneath his body when his rib cage is up

#00:00:23-7# now the horse is not saying no anywhere in the maneuver

#00:00:28-7# and he does what's being asked for and it looks like he is trying to be a nice horse it's just not a very athletic back up

Judge B

Judge B was given the videos and asked for a written judgment.

Horse no. 1

Video 1 zeigt ein gleichmäßiges, williges BU, welches jedoch nicht über einen runden Rücken geritten wird. Für einen runden Rücken trägt das Pferd den Hals ein wenig zu hoch und auch die Kopfposition ist hinter der Senkrechten (Zügel). Das BU somit leicht unter average, wird aber das Gesamtmanöver noch nicht negativ beeinflussen.

Horse no. 2

Video 2 zeigt ein Pferd, dass nach dem Stopp mit dem Gewicht noch stark auf der Hinterhand ist und dadurch beim Beginn des BU Probleme mit der Balance hat. Auch hier wird das BU über den Zügel geritten und das Pferd zeigt mit dem Schweif Widerwillen gegen Zügel- und Sporeneinsatz. Hals- und Kopfposition ähnlich wie bei Video 1. Als Teilmanöver hier schon mit poor zu bewerten und wird das Gesamtmanöver negativ beeinflussen.

Horse no. 3

Video 3 zeigt ein williges BU mit rundem Rücken. Das BU ist eine ausbalancierte, flüssige Bewegung. In der Beurteilung sicher als good zu bezeichnen. Wären die Zügel etwas länger, könnte die Nase des Pferde auch noch in die Senkrechte gehen, womit sich das Gesamtbild noch etwas verbessern könnte. Das BU könnte das Gesamtmanöver aber schon leicht ins positive beeinflussen.

Horse no. 4

Video 4 zeigt ein BU bei welchem das Pferd auch sehr stark durch die Zügelhand auf die HH geritten wird. Dadurch kommt der Hals nach oben und der Kopf hinter die Senkrechte und der Rücken lässt ein wenig an Rundheit missen. Das Pferd geht jedoch flüssig und willig rückwärts, womit das BU als Durchschnitt zu bewerten ist.

Horse no. 5

Video 5 zeigt ein BU bei welchem das Pferd durch die Zügel sehr stark in die Versammlung gezogen wird. Der Rücken krümmt sich auf, der Kopf zu stark hinter der Senkrechten. Das Pferd läuft zwar rückwärts, jedoch in keiner natürlichen Selbsthaltung, das Manöver wirkt gezwungen und ist daher auch nicht mehr als Durchschnitt.

Horse no. 6

Video 6 zeigt ein ungleichmäßiges BU. Das Pferd zeigt Widerwillen und muss mit der Zügelhand in die Versammlung geritten und zum Rückwärtsgehen animiert werden. Ein eher schlechtes BU, welches das Gesamtmanöver mit Sicherheit negativ beeinflusst.

Horse no. 7

Video 7 zeigt ein unwilliges BU bei welchem das Pferd mit den Zügeln stark rückwärts gezogen wird. Das Pferd rollt sich auf, Kopf natürlich stark hinter der Senkrechten. Auch das Maul öffnet sich durch den Zügelzug ständig. Trotz allem entsteht nie ein runder Rücken. Auch dieses BU wird das Gesamtmanöver negativ beeinflussen.

Horse no. 8

Video 8 zeigt ein Pferd, das mit leichtem Zügelkontakt willig rückwärtsgeht. Hals- und Kopfhaltung sind OK. Diese BU ist glatter Durchschnitt. Für eine Bewertung über dem Durchschnitt müsste die Rückwärtsbewegung nur noch etwas flüssiger sein.

Horse no. 9

Video 9 zeigt ein williges, flüssiges BU mit rundem Rücken. Hals- und Kopfhaltung sind perfekt. Die ersten Schritte sind jedoch nicht Takt rein, vermutlich beim Liverichten aber gar nicht erkennbar. In der Bewertung auch Durchschnitt und wird die Gesamtbeurteilung nicht beeinflussen.

Horse no. 10

Video 10 zeigt ein BU bei welchem das Pferd rückwärtsgezogen wird. Der Hals kommt hoch, das Pferd rollt sich im Genick auf und hat deshalb auch keinen runden Rücken. Auch hier im Maul Unwillen erkennbar. Diese BU ist dazu geeignet ein Gesamtmanöver im "Graubereich" negativ zu beeinflussen.

Judge C

Judge C was sent a link to the videos and asked for a written judgement.

Here is my 'scoring':

Horse no. 1. Below average

Horse no. 2. Very poor

Horse no. 3. Very good

Horse no. 4. Correct

Horse no. 5. Good

Horse no. 6. Very poor

Horse no. 7. Below average

Horse no. 8. Poor

Horse no. 9. Below average

Horse no. 10. Correct

Curriculum Vitae

Alexandra Hasl, Bakk.

Curriculum Vitae

Personal Information:

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Education:

09/1990 – 06/1994	Franz Jonas VS St.Pölten (elementary school)
09/1994 – 06/2002	Gymnasium der Englischen Fräulein St. Pölten (secondary high school)
12/06/2002	High School Diploma
09/2002 – 03/2006	University of education Krems (Pädak der Diözese St. Pölten)
10/03/2006	Diplomprüfung für die UF: Englisch und Leibeserziehung (teacher for secondary school – English and Sport)
10/2006 – 05/2011	University of Vienna: bachelor degree in sport science
10/2011 – to date	University of Vienna: master degree in sport science

Further Qualifications:

20/12/2002	permission to organize a sports week in winter - exam in skiing (Leiterprüfung Ski)
05/2003	permission to organize a sports week in summer - exam in riding (Leiterprüfung Reiten)
17/12/2004	snowboard instructor exam („Begleitlehrerprüfung“)
15/01/2006	ski instructor level I (Anwärter)
14/01/2007	ski instructor level II (Landesschilehrer 1)
09/2008 – to date	state-certified trainer for athletics
02/04/2010	ski instructor level III, part 1 (Landesschilehrer 2)
19/12/2010	ski instructor level III part 2 (fertige Landeslehrerausbildung)
10/2011 – 03/2013	handball instructor level C
29/09/2013	diploma: commercial masseuse

Work Experience:

09/2002 – 06/2005	curative educations and social therapy with horses (counsellor)
SS+WS 2004	internship (teaching at Dr. Theodor Körner secondary school for 4 weeks)
12/2005 – to date	ski instructor at Hermann Maiers' in Flachau
12/2006 – 04/2009	ski instructor at Ski school Hochkar (weekends)
04/2008 – 08/2010	employee at STKZ Weinburg – focused on performance diagnostics and assistance in training (until 08/2010, later as temporary help)
06/2010	lecturer at BSPA Vienna
09/2010 – to date	teacher for the Hypo NÖ project „Ball in der Schule“
04/2011 – to date	manager Mrs.Sporty Neulengbach (fitness club)
since 02/2013	sabbatical leave (until 02/2014)

Skills:

Language skills:	German (native language), English, French, Latin
Computer skills:	High School Diploma in informatics, data processing as well as statistic programs (Microsoft Office, SPSS,...)
Driving licenses:	B, BE

Sports:

1988 – 2004	<i>vaulting</i> at RC St.Pölten (team and individual) competitions since 1991 Vaulting badge in bronze (1997) and silver (1999) pool of youth athletes until 2002
1988 – to date	<i>skiing</i>
1993 – to date	<i>riding</i> : Western Riding Certificate 2002; shows since 2006
2004 – 2009	<i>athletics</i> at ULV Krems
2013 – to date	<i>Muay Thai</i>

Erklärung

„Ich erkläre, dass ich die vorliegende Arbeit selbstständig verfasst habe und nur die ausgewiesenen Hilfsmittel verwendet habe. Diese Arbeit wurde weder an einer anderen Stelle eingereicht noch von anderen Personen vorgelegt.“

„ I state that the present thesis was written independently and only the adduced resources were used. This thesis was neither exhibited elsewhere, nor used by any other person.“