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What are they looking at?

Visual Search Behaviour of Grand Prix Judges

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Zusammenfassung

In den letzten Jahren wurde das Richten im Dressursport heftig kritisiert. Die Problematik hierbei war die Unbeständigkeit und Unklarheit der Endnoten, welche durch professionelle Richter innerhalb der Prüfung für einzelne Lektionen vergeben werden. Die Noten lagen zum Teil weit auseinander und konnten aufgrund einiger Unregelmäßigkeiten nicht mehr in Angesicht des Ganzen nachvollzogen werden. Die aktuellen Richtlinien für Dressursport erscheinen durch ihre extreme Detailliertheit in Bezug auf ihre Durchführbarkeit suboptimal. Die Richtlinien listen eine große Anzahl von Kriterien auf, welche es für die einzelnen Lektionen zu beachten und zu beurteilen gilt. Angesichts der Zeit- und Aufnahmefaktoren erscheint es schwierig diese einzuhalten. Als Folge des Informationsüberschusses kommt es automatisch zu Vorurteilen oder sogenannten ‚Short-Cuts', welche aus der begrenzten menschlichen Aufnahmefähigkeit resultieren.

Aufgrund dessen, liegt es nah die virtuellen Suchstrategien der Richter zu analysieren um somit feststellen zu können wonach diese eigentlich schauen. Dies ermöglicht es, im Vergleich mit den Richtlinien, Rückschlüsse auf Diversitäten zu ziehen. Somit wird die Grundlage geschaffen um die Richtlinien zu vereinfachen und dadurch das Richtverfahren anzugleichen. Dies würde dazu führen, dass Richter nicht mehr aus der überladenen Liste der Kriterien aussuchen, sondern sich im besten Fall auf die nachweislich wichtigsten Bereiche der Evaluation einheitlich bedienen.

Die Ergebnisse dieser Studie zeigen, dass sich die 17 teilnehmenden Richter in erster Linie auf die Vorhand, beziehungsweise den Vorderarm konzentrierten. Desweiteren wurde das Schienbein sowie die Fessel und der Huf des Hinterbeins die meiste Aufmerksamkeit zuteil. Bezüglich des Reiters ist es dort vor allem der Unterschenkel der betrachtet wird. Diese Unterschiede in den Fixationen für die Körperteile wurden alle als signifikant belegt (Wilks Lambda= 0.087; F (78.604); p= 0.000). Desweiteren konnten beachtliche Unterschiede in der Betrachtung der einzelnen Lektionen gezeigt werden. So wurde vor allem die Passage sehr genau betrachtet und erreicht somit die Höchstzahl an Fixationen (mean fixation 124.06; ± 29.34). Wider Erwarten konnte keine signifikante Korrelation zwischen der Anzahl der Fixationen und der finalen Bewertung belegt werden.

Summary

Throughout the last years, the equine dressage sport was discussed heavily due to controversies in the consistency of judgment. The criticism was raised through diverging results especially in high-end competitions. The current judging regime seems to be redundant of criteria to evaluate within the exercises. The combination of limited processing capacity of the human and factors like stress, time pressure and the necessity to do right, leads to an overextension of human abilities. Due to this problem the brain creates and applies 'short-cuts' in the decision-making process.

In line with this, it is important to analyse the visual search behaviour of judges in order to get an insight in what they are actually looking at. This enables to detect diversities between the abilities and the current judging regime. By simplifying the judging system through detection of the most important areas of interest, the regime could be adjusted and therefore become fairer.

The outcome of the study showed that the 17 participating judges looked primarily on the front part of the horse, especially the forearm. Furthermore, considering the back of the horse, the area of the lower hind limb got particular attention, namely the cannon bone, the pastern and the hoof. The rider got most fixations on his lower leg. These emphasises of fixations were proven to be significant (Wilks Lambda= 0.087; F (78.604); p= 0.000). Additionally, significant differences in fixation count within the single exercises were shown. The passage got most fixations (mean fixation 124.06; ± 29.34). Against the assumptions there is no correlation between the total fixations and the total score.

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1. Introduction

As an aesthetic sport the discipline of equestrian dressage, strives for performance in perfect harmony. At high level, riding dressage is far more than performing a number of exercises; it represents years of hard work. Riders try to become the perfect match with their horses and show what a horse-rider relationship can achieve with correct gymnastic, training and a lot of discipline. Years of training and education are essential.

Dressage training requires the rider to train the horse to react sensitively and obediently to his weight-, rein-, and leg-aids. The aim is to perform with almost invisible aids and in absolute harmony resulting in a highly aesthetic presentation. A well-ridden horse is the most important requirement, also in view of safety essentially in all equestrian disciplines. Dressage at its best improves physical and mental health of the horses, as it increases strength and mobility of joints and muscles. Seeing that dressage may be considered as the basis for all equestrian disciplines, the objective and transparent assessment of what is considered good becomes all the more important.

At competitive level, participating horse-rider combinations get evaluated by educated and qualified judges, who, by giving marks to the different exercises performed, effectively pass judgement on the correctness of training in walk, trot and canter. During the highest level of dressage, the Grand Prix, judges assess the total obedience of the horse to the rider's aids while performing exercises of considerable difficulty. The Grand Prix (2009) test for example consists of a total of 33 exercises, 3 of which are performed in walk, 20 in trot and 10 in canter. All gaits are divided into extended and collected exercises (see Annex 1). There are different criteria for each gait and movement, resulting in a myriad of information judges have to assess within a relatively short period of time and, depending on the importance of the competition, under considerable pressure. There can be no doubt, therefore, that the current

judging regime is extremely complex and difficulties while judging, such as stress, time, amount and complexity of information add up to a very demanding task for the judges.

Throughout the past few years, dressage judging raised controversy in consistency as evaluations and marks were difficult to understand by riders, trainers and the public alike, especially in high-end performances. A discussion about fairness and objectivity subsequently arose resulting in a number of important changes initiated by the FN (Fédération Equestre Nationale) as the umbrella organization of equine sport and breeding in Germany and the FEI (Fédération Equestre Internationale). Allowing half-marks in 2011 instead of only full-marks for the evaluation did not show the expected outcome so far. Judges are apparently used to give full-marks from 0 (not performed) up to 10 (excellent) that they still end up with very close end-results in the rankings. Additionally the international judging committee applied ground-breaking changes in the organizational structure. The first 'Dressage Judge General' was appointed to increase and coordinate discussions between judges. A separate 'Judges Supervisory Panel' has been set to work since the 1st of January 2011 and may, if necessary, overturn the final score. It may be argued then, that even though the organising bodies of the sport of dressage were trying to make the judging process more feasible and transparent, they ended up in showing that the judging process is extremely complex, with individual judges reaching different conclusions about the performance of horse-rider combinations.

There can be no doubt that in order to equip the sport of dressage with a judging system that is able to reflect the quality of horse-rider performances an objective analysis of what it is that judges pay attention to when judging a dressage test is required. Such an analysis would provide a starting point for, on the one hand determining which elements in a horse-rider combination provide the most information, and, on the other, to what extend attentional focus differs between judges. Essentially, this would enable a comparison of the guidelines and the

reality of what judges are able to process. It is vital to investigate what judges are able to focus on respectively what they consider as important to look at. Expecting a professional judge to have a certain strategy of evaluation, making it visual will help to make judging more transparent and therefore fairer. The aim of the current study was therefore to investigate visual attention of Grand Prix judges while evaluating a horse-rider combination.

2. Literature Review

2.1 *Decision making process in sport*

The process of judging in its complexity includes different procedures which lead to categorization and decision-making. Described in simple terms, while watching sport performance, a judge assimilates different pieces of information, filters the most important ones, compares them to previously perceived elements and decides which has been better (Plessner & Haar, 2006).

The decision-making process is basically dependent on 3 main steps:

1. Perception,
2. Categorisation,
3. Memory processes/ knowledge.

Firstly, a visual stimulus has to be perceived (e.g. *perception* and appropriate selection of the movement/exercise). Judges are asked to evaluate the 'true' performance, meaning the correct perception of the relevant information given by the horse-rider combination. In order to this, the judge needs to be able to select only relevant information and process it accurately, in order to ensure that the final evaluation mirrors the athletes' performance accurately. Secondly, the perceived stimuli need to be encoded and given meaning (e.g. *categorization* of current information referring to existing knowledge). The perceived information of the athlete's performance is processed by estimation and classification to compare it to prior knowledge which is stored in the judges' memory. Finally, the perceived and encoded information is compared to the retrieved memories and integrated into the current judgement (e.g. integration of available information into the judgement of quality based on perceived and pre-existing *knowledge*) (Plessner & Haar, 2006).

Looking at the scheme it is important to put emphasis on the fact that the first step, the perception, can be referred to as the most important one. There is no doubt, that the performance must be perceived accurately in order to refer to the 'right' information in the judgement process (Plessner & Haar, 2006). A sport judge can only make right decisions when selecting the relevant information and processing this in the evaluation of performances. Considering the limited amount of time the judge has to make a decision, it is vital to be able to perceive events quickly and accurately in these complex sport settings (Williams & Elliot, 1999).

2.2 Judging in equestrian sports

Sport judges are asked to evaluate numerous factors of performance. Especially in equine sports the process of judging is particularly complex as the judges have to include the performance information of two athletes performing together. The full load of criteria in aesthetic sports such as dressage often overextends human ability to assimilate information (Plessner and Haar, 2006). Essentially, the difficulties for dressage judges when evaluating horse-rider combinations may again be split into three elements:

1. The complexity of the information to be processed;
2. the aesthetic nature of the sport (meaning that "beauty" may indeed "be in the eye of the beholder"); and
3. Human processing ability.

2.3 Complexity

First of all the equine dressage performance itself contains a vast load of information which need to be considered in the evaluation. Furthermore, the sport of dressage depends on the interaction of two beings – the horse and the rider (Wolframm & Micklewright, 2008). Each part is already offering a lot of elements to look at. For instance, the rider is equipped with three aids to ride the horse with: reins, leg and weight which control and navigate the horse and need to be evaluated concerning their effect and correctness. Furthermore the rider's seat and position needs to be considered. Then, the horse with its three gaits, its paces and impulsion, so the desire to move forward, elasticity of the steps, suppleness of the back and engagement of the hind quarters are observed. Finally the combination of both, the submission is evaluated, implying the attention and confidence, harmony, lightness and ease of movements, acceptance of the bridle and lightness of the forehand (Grand Prix de Dressage evaluation sheet, 2009). All these factors need to be integrated into the evaluation and it is remarkable, that the time span for single exercises is exceptionally short. The number of criteria considered and the individual perception in limited time create a very complex scene to be judged.

2.4 *Aesthetic sports*

Aesthetics in its definition by the encyclopaedia are defined narrowly as the theory of beauty, or more broadly as that together with the philosophy of art (The American Heritage Dictionary, 2009). So, looking at dressage sport as beauty and art, it becomes obvious, that the performance of exercises cannot be measured in objective terms such as length, height or speed. Judging dressage as an aesthetic sport always includes individual preferences which influence the marks. Even though judges try to avoid subjective evaluation, no one can guarantee not to be influenced by reputation, expression, colour or others (Plessner & Haar, 2006). Even the load of detailed criteria for evaluation does not ensure an objective

judgement. In the end, it is the individual taste, the way of riding, the horse's shape, the rider's attractiveness that involuntarily affects the final judgement.

2.5 Human processing ability

The human brain is limited in its ability to process information (Plessner & Haar, 2006). It may be argued that the vast load of information given by the horse-rider combination pushes the judge to his limits of absorbing capacity. Considering the combination of all factors of a dressage performance combined with the long list of judgement criteria, it becomes obvious that time and complexities result in an overload of information. It has been argued that in order to handle this overload, the human brain creates short-cuts in order to simplify the decision-making process (e.g. MacMahon & Ste-Marie, 2002; Paull & Glencross, 1997; Ste-Marie, 1999, 2000). Thus, filtering the information automatically, the result is an evaluation which may be biased (Hastorf & Cantril, 1954). Research has shown that biases in performance evaluation can be caused by several factors. Oudejans et al. (2000) showed that in football matches the referees' errors in offside decisions do reflect the **viewing position**. Additional research demonstrated the same effect of positioning when judging the cross on rings in gymnastics (Plessner & Schallies, 2005). It is also important to know that research showed that referees were not able to correct for potential biases in viewing position. The so-called **sampling** bias is based on the overestimation of certain performance criteria in relation to others (Fiedler, 2000). The judges' evaluation is also influenced by his perceived knowledge, being referred to as the **memory** bias (e.g. Ste-Marie et al., 1991, 1996, 2001, 2003; Tversky & Kahneman, 1973). The **rank-order** bias refers to the tendency to expect a good or bad performance as a function of the rank order in which the performance takes place (e.g. Bruine de Bruin, 2005; 2006). Obviously, the **reputation** bias applies to the prior reputation of an athlete or a team (Findlay & Ste-Marie, 2004; Jones, Paull & Erskine, 2002;

Lehmann & Reifmann, 1987; Rainey, Larsen, & Stephenson, 1989). Another familiar effect, which is probably recognised by every person having attended a sport performance, is the **crowd-effect** meaning that the noise level of audience may serve as indicator whether judgement is perceived as accurate. Nevill et al. (2002) investigated this effect on soccer referees' decisions concerning potential foul situations and they assumed that referees have learned to use crowd noise as an indicator for the seriousmess of the foul and ultimately Courney & Carron (1992) showed the strong effect on decisions made by the referees. Furthermore, the **patriotism** bias may influence the performance evaluation by the feeling of belonging to a certain group being the particular nationality (Myers et all, 2006). And the last bias to be named here is the **conformity** bias which refers to the tendency to adapt own scores to those of judging colleagues either through "normative" or "informative" influencing[1] (e.g. Boen et al., 2006; 2008; Plessner, 1999; Vanden Auweele et al., 2004).

2.6 Judging "short-cuts"

The combination of information overload and biases in judging lead to the next step which is the development of judging, or decision-making, "short-cuts". These short-cuts are automatically built by the human brain in order to simplify the decision-making process and the more complex and numerous the information, the more short-cuts will be built (M.Soules, 2007). These short-cuts, built by the individual, rely on different aspects of the performance. Faced with making complex decisions in limited time, research has shown that referees strongly rely on judgemental heuristics, or short-cuts, (i.e. quick and easy decision rules) to help them make their decisions (Mascarenhas, O'Hare, & Plessner, 2006). Instead of needing

[1] Normative: people want to conform to the group norm as they fear being rejected by their fellow group members (peer pressure)
Informative: people do generally want to make a correct judgement, yet, if uncertain, believe that others probably know better, and thus follow their lead (e.g. supermarket queues)

to process all the facts and consider all the options, people can often make good decisions using simple "fast and frugal" (f&f) heuristics; shortcut choice strategies that ignore a lot of information (Todd, 2007). F&f short-cuts require fewer cognitive steps because they use less information (frugality) and allow a decision to be reached much faster (Simon, 1955, 1957). F&f heuristics exploit evolved capacities and structures of environment, comprise a set of process rules and they are very simple (Gigerenzer & Goldstein, 1996). As Todd (2007) said, the trick is to ignore the right pieces of information that is the unnecessary bits. Or put it the other way, the trick is to search for the few pieces of information that will be the most useful and process them appropriately. It could be argued then, that judges are likely to have unconsciously or consciously developed individual search strategies that allow them to reach the 'right' judgement.

"*Judges need to be able to identify the information-rich areas of the shown display, direct their attention appropriately, and extract meaning from these areas efficiently and effectively*"

(Mann, Williams, Ward, Janelle, 2007).

2.7 *Visual Search Behaviour in judging*

Visual search can be described as the active but not always consciously applied scan of objects. There are several examples which find their base in this scheme of search. For instance, we recognise people via scanning their facial characteristics or we are looking for a certain brand in the supermarket by searching for particular colours, shapes or logos. Our brain is able to identify certain characteristics, either shapes or colours, which are well-defined and therefore easy to detect. The eye focuses on relevant characteristics as it is impossible to process all the input given by the object (see, e.g., Tsotsos, 1990). Our memory runs through previous knowledge that helps us recognising people or certain movement

patterns for example. Visual Search behaviour studies analyse this scanning processes in order to find out whether there is a certain regularity or repetition in the process. The variables that are typically measured with Eye Trackers are for instance fixation durations, fixation counts and gaze directions in certain objects.

The Visual Search Behaviour can be detected and analyzed by an Eye Tracking tool with a system which is able to record the eye movement through scanning the pupil and following the gaze. This method has been used in several sport studies to investigate the judges' as well as the athletes behaviour (e.g. Oudejans et al. , 2000, 2005; Baldo, Ranvaud, & Morya, 2002; Helsen, Gilis, & Weston, 2006), however, to date no study has been conducted analyzing the visual search behaviour in the sport of dressage riding yet. In a previous study, researchers from the equine science department of Nottingham Trent University (NTU) used the Tobii Instruments to get an insight on what show jumping riders look at while facing a jump. This study showed, that elite show jumpers focus intensively on the highest pole of the jump and do not leave this focus until the horse takes off. This way, the researchers could give training advises with a scientific background.

Being able to select the most important information by visualizing the visual search behaviour of dressage judges will help to make the judging regime more applicable and therefore more equal among the judges. It is essential to find out what the areas of interest are regarding the single exercises in order to be able to simplify the judging process and in this way make it fairer for all the participants. A reduced list of criteria for judging can make the process more accurate and effective which can result in more comprehensive evaluations.

"*Selecting the right information is crucial to performance"*

(Karelaia, 2005)

In our case, the right information will be provided by focussing on the right areas of interest. The aim of the current study is to identify which body parts of a horse-rider combination Grand Prix judges visually focus on when judging dressage performance. Furthermore, differences in visual focus between judges at different levels of experience will be investigated. This study aims to investigate the visual search behaviour of 17 experienced Grand Prix judges and its main objective is to visualize and analyze their attentional focus while judging the performance.

3. Research questions

Main questions

- What do dressage judges look at while evaluating a Grand Prix test?
- Do judges follow a certain search strategy?

Sub questions

- What is the frequency of fixations on the horses' body?
- Which parts of the horse and the rider get most fixations?
- Is there a correlation between the total number of fixations and the final score?

4. Materials & Methods

4.1 Participants

17 judges were asked to judge an unknown horse-rider combination performing the 2009 Grand Prix de Dressage. 4 judges were aged between 41 and 50, 6 judges between 51 and 60 and 7 judges were between 61 and 70 years old. 7 female and 10 male judges participated and 15 of them competed in dressage sports. It is remarkable that 12 competed on elite level, 3 on advanced level and the other 2 on novice and intermediate competition level. All of the participants have been judging for more than 20 years, only the distribution of experience on the current judging level showed differences. The levels of judging were either 4*, 5* or National Grand Prix. 2 judges did state judging experience on the current level between 0 and 2 years, 3 of them answered 3 to 5 years, 5 with 6-10 years and 7 participants have been judging on the current level for more than 10 years (see also figure 1)[2].

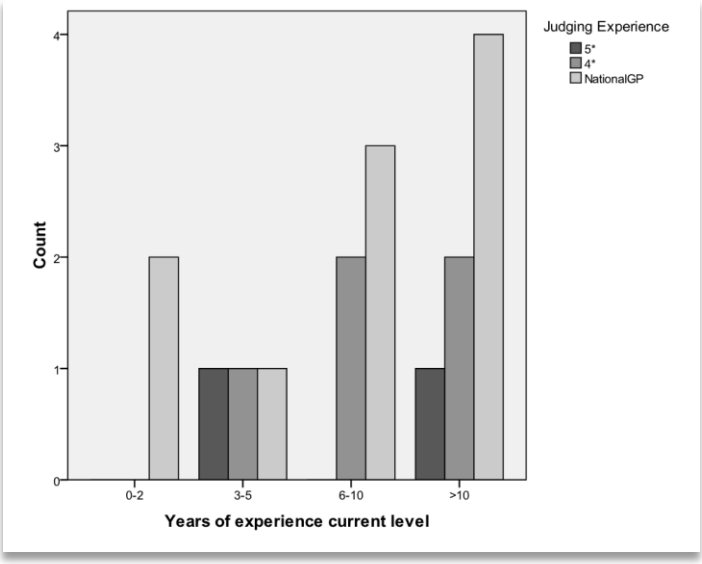


Figure 1 – Experience level of the judges

In order to ensure that all judges evaluate the exactly same performance, they were asked to judge the test from a video while being recorded by the Tobii Eye Tracker. All judges were asked to sign a written consent form, stating that all information relating to them and their test results will be treated confidently. Any publication of the data or use of the data for future training purposes would ensure anonymity and confidentiality of participating judges. All participating judges were able to withdraw from the study at any point and without

[2] For all descriptive statistics see also Annex 2

explanation.

The testing was carried out on three different occasions namely the World Cup Qualifier in s'Hertogenbosch "Indoor Brabant" (26th/27th March), a judging seminar for international Paraolympic Dressage judges in Ermelo (3rd of April) and an additional seminar for Grand Prix judges in Ermelo (6th of April). The judges participating in this study were firstly informed about the precise procedure and they got insight into the basics of the Eye Tracker, the research background and the processing of data. After having signed the consent form, the researchers calibrated the Eye Tracker. It was important to pay attention to those judges wearing eye-glasses as the possibility was given that these would distract the Eye Tracker, so that the data would not have been collected without disturbances. For these participants the exact calibration was very important. In order to execute the judging process in a realistic manner and to get as much data as possible, the participants got the evaluation sheet of the Grand Prix test and a researcher was noting marks and comments for each exercise, just as in the real judging situation. After having evaluated the performance, the judges answered questions about their age, gender, own experience in riding concerning the discipline and competition level, level of judging, years of judging and the years they have been judging at the current level. The complete data collection including all declarations took about 30 minutes per participant.

4.2 The Grand Prix test

The performance chosen to be used in this research was a Grand Prix performance of 2009 ridden by an unknown horse-rider combination. The rider has competed at Grand Prix level already, but not the horse. Due to time limitations, this current study was concerned with the analysis of the trot sequences. These included 19 exercises being half-passes to each side, piaffe and passage, collected and extended trot. Within these exercises, the fixations on

different body parts of the horse and the rider were analyzed. This was done by replaying the recorded Eye Tracker video in slow motion, counting the single fixations and registering them in a suitable table[3].

4.3 The Tobii Eye Tracker XL 60

The Tobii Eye Tracker XL 60 which was used in the study measures eye movements by following the gaze directions of the pupils. An eye tracker estimates the point of gaze with extreme accuracy using image sensor technology that finds the user's eyes and calculates the point of gaze with mathematical algorithms. The pupil center corneal reflection method enables the eye tracker with several near-infrared illuminators, invisible to the human eye, to create reflection patterns on the cornea of the eyes. Multiple image sensors register the image of the user's eyes. Image processing is used to find the eyes, detect the exact position of the pupil and the iris, and identify the correct reflections from the illuminators and their exact positions. A mathematical model of the eye is used to calculate the eyes' position in space and point of gaze. Two different illumination setups can be used with pupil corneal reflection eye tracking; either bright or dark pupil eye tracking. With bright pupil eye tracking the illuminators are placed close to the optical axis of the imaging sensor, which causes the pupil to appear lit up (this is the same phenomenon that causes red eyes in photos). With dark pupil eye tracking illuminators are placed away from the optical axis causing the pupil to appear darker than the iris. The eye tracker uses both methods to calculate the gaze position and can accommodate larger variations in experimental conditions and ethnicity. Before an eye tracking session starts, the system calibrates the user's eyes. During calibration, the eye tracker measures characteristics of the user's eyes that are required to accurately calculate gaze direction. The Tobii eye tracker uses a 5-point calibration and the procedure takes only a

[3] See Annex 3

few seconds. No adjustments of the equipment or the positioning of the user is required. The freedom of the head movement is defined by the head movement box. This is the imaginary box in which a user can move his/her head and still be tracked by the device. Head movement within the eye tracking box has very little impact on gaze data accuracy and the system can even track users when one eye is outside the sensors' visual field (Tobii Technology AB, 2011).

The data was analyzed by counting the gaze fixations on certain parts of the horses' body including the following criteria.

fore-end	hindquarters	rider
Head	Croup	Head
Mouth	Tail	Torso
Poll	Thigh	Hand
Neck	Flank	Thigh
Shoulder	Lower leg	Knee
Forearm	Hock	Lower leg
Knee	Cannon + lower	
Cannon +lower		
Breast		

Figure 2- table of horses' body parts used for analysis

4.4 Statistical Data Analysis

The collected data was entered into SPSS 17.0. First of all basic statistics were conducted with help of the descriptive statistic tools. This descriptive test was needed in order to show the number of fixations on different parts of the horse, the rider and within exercises. Furthermore the statistical report shows the mean of fixations and the standard deviation. The dataset was split into groups in order to continue with further testing for correlations between single factors. Variables that included the total fixations on the front of the horse, total fixation on the back of the horse and the total fixation on the rider were inserted. With help of these new variables, the significant differences of fixations could be calculated by using the repeated measures analysis of variance. Post-hoc pairwise comparisons showed the significance level between individual factors. The significance value was set at $p < 0.05$.

5. Results

The total sample number of 17 judges was used for the data processing, as all samples were valid.

5.1 Fixation count – horse front, horse hind, rider

The data analysis showed that the fixations on the horse ranged from 130 to 383 times (mean fixation 297.71, ± 59.87). Most of the fixations were found on the front of the horse (mean fixation 183.24, ± 40.67) and the least on the rider (mean fixation 54.82, ± 21.61)[4] (see figure 3).

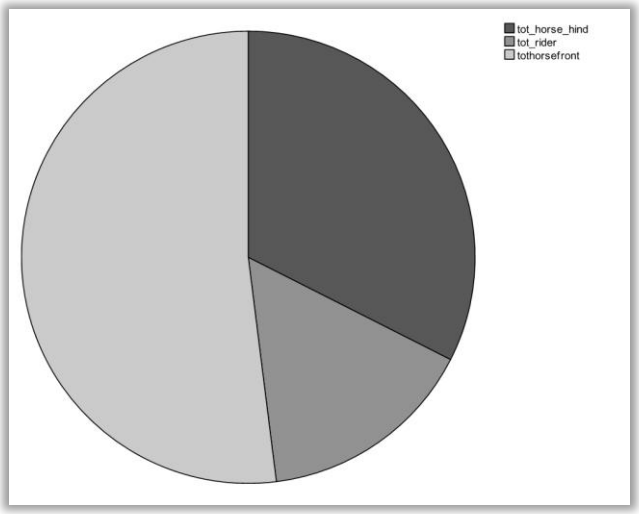


Figure 3 – distribution of total fixations

The samples were tested for a difference in fixations on the horses' front, the horses' back and the rider. For these tests the repeated measures ANOVA was used.

[4] See Annex 4

The multivariate test showed the Wilks Lambda= 0.087; (F (78.604); p= 0.000) meaning that there is a significant difference between the three individual factors. The pairwise comparison showed that there is a significant difference (p=0.000) between the fixations on the front, on the back and the rider. The results were visualized with a Boxplot diagram (see figure 4).

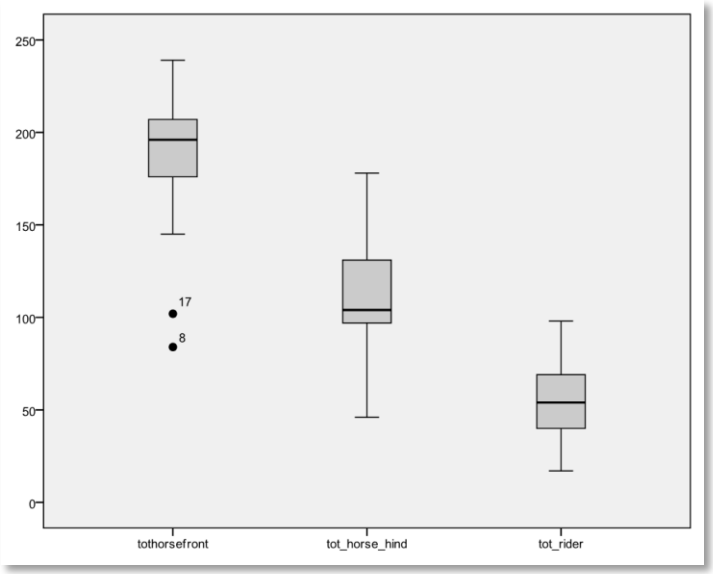


Figure 4 – significance between the factors total fixations front, total fixations hind and total fixations rider

5.2 Fixation count – single parts of the body

The samples were tested for their fixation count on the single parts of the horses' body. Firstly the forehand was analyzed. The descriptive statistics showed that most of the fixations were found on the forearm ranging from 18 to 88 fixations (mean fixation 42.24 ± 16.65). The least fixations were measured on the poll. The minimum fixation number was 0 and the maximum 29 (mean fixation 3.59 ± 6.99)[5]. The visualization of the result was drawn by a bar chart (see figure 5).

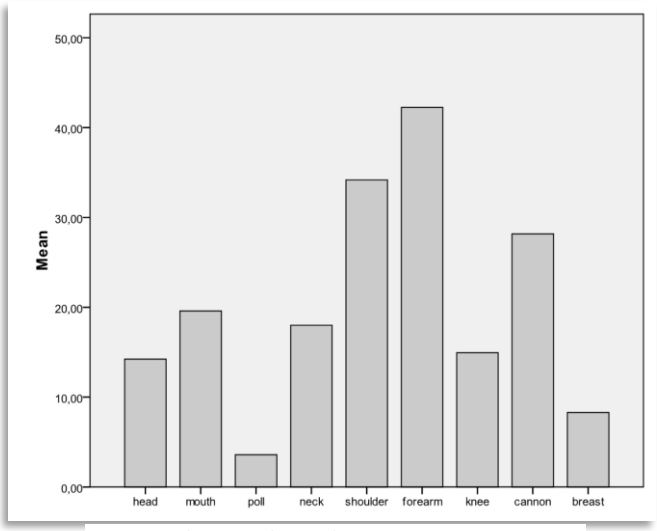


Figure 5 – fixations front of the horse

[5] See Annex 6

The mean fixations on the single body parts were calculated for the back part of the horse. There the researcher found a maximum of fixations for the cannon bone (hind) of the horse (min. 11, max. 131, mean fixation 54.00 ± 29.58) and a minimum for the tail (min. 2, max. 12, mean fixation 5.30 ± 3.08)[6] (see figure 6).

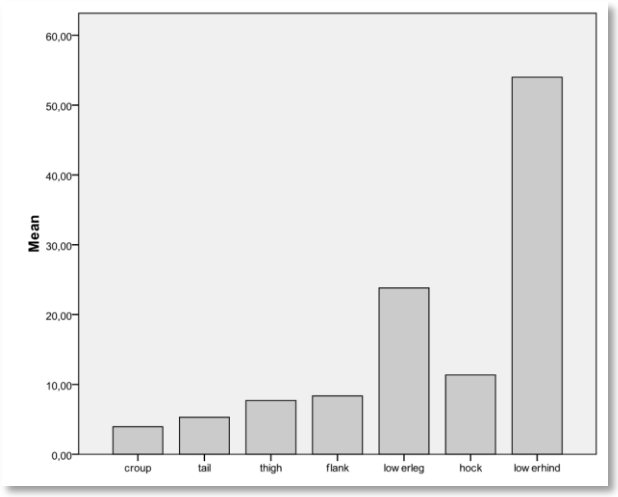


Figure 6 – fixation count on hindquarters

The total fixation count on the rider was analyzed with help of the descriptive statistics tool. Here the study showed most fixations on the riders' lower leg (mean fixation 27.65± 13.54) and the lowest number fixations were found on the head (mean fixation 2.47 ± 2.90)[7]. The bar chart (see figure 7) shows the distribution of fixations on the rider.

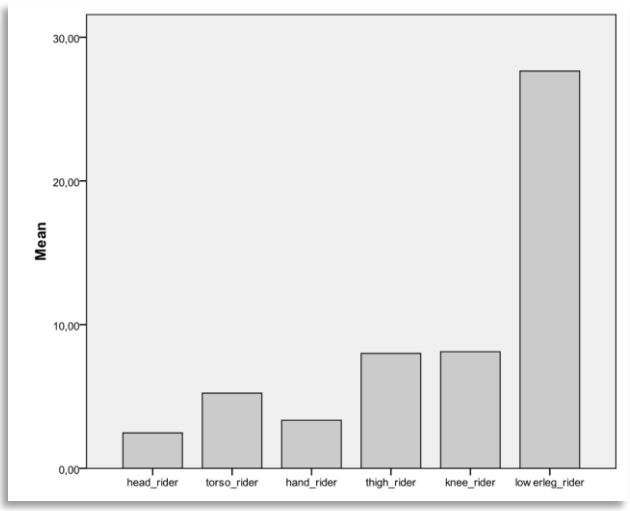


Figure 7 – fixation count rider

[6] See also Annex 6
[7] See also Annex 6

5.3 Fixation count – exercises

In collected trot the fixations ranged from 26 to 119 (mean fixation 72.24; ± 21.57), in extended trot from 36 to 85 (mean fixation 65.35; ± 11.80), in half-pass from 27 to 60 (mean fixation 46.24; ± 9.06), in passage from 48 to 183 (mean fixation 124.06; ± 29.34) and in piaffe from 11 to 110 (mean fixation 48; ± 20.75)[8]. The overall distribution of fixations between the exercises was visualized in a bar chart (see figure 8).

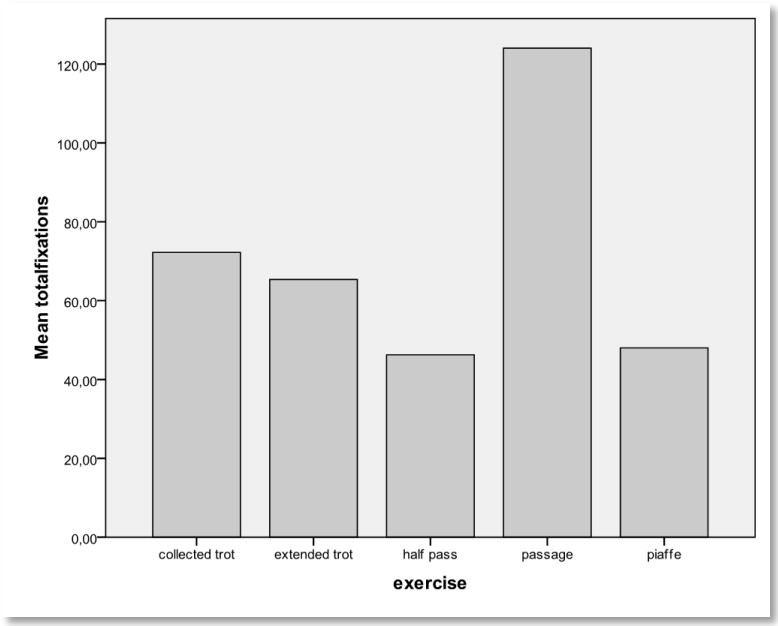


Figure 8 – bar chart of the distribution of fixations between the exercises

The significance of the difference between fixations in collected trot (1), extended trot (2), half-pass (3), passage (4) and piaffe (5) was tested with help of the repeated measure analysis. The multivariate testing of Wilks Lambda shows a value of 0.044 (F (70.977); p= 0.000) indicating that there is a significant difference. The pairwise comparison of the factors showed that the fixations in collected trot are significantly different to those in half-pass (p=0.000), passage (p=0.000) and piaffe (p=0.000). The fixations in extended trot show a significant difference to those in half-pass (p=0.000), passage (p=0.000) and piaffe (p=0.000).

[8] See also Annex 7

The fixations in half-pass are significantly different to those in collected trot (p=0.000), in extended trot (p=0.000) and passage (p=0.000). The passage fixations show a significant difference to fixations in collected trot (p=0.000), extended trot (p=0.000), half-pass (p=0.000) and passage (p=0.000). And finally, the fixations in piaffe show significant difference to collected trot (p=0.000), extended trot (p=0.000) and passage (p=0.000)[9].

5.4 Fixation count – body parts and exercises

Furthermore, the samples were tested for a difference in fixations between exercises and the front respectively the hind of the horse.

Data analysis showed the most fixations in passage being 64.82 (± 19.59) on the front part of the horse and 42.76 (±15.34) on the back of the horse. The least fixations were found in piaffe on the front (mean fixation 20.76; ±8.92) and on the horses' hind in half-pass (mean fixation 5.88; ±4.43)[10].

Exercise	**Horse front** *(number of fixations)*	**Horse hind** *(number of fixations)*
Collected trot	40	18
Extended trot	27	29
Half-pass	32	6
Passage	65	43
Piaffe	21	18

Table 9- Simplified table of fixations within the exercises

[9] See Annex 8
[10] See Annex 9

The outcome of the calculation for the different exercises and the fixation distribution on the front/back of the horse was also made visible with help of a clustered bar chart (see figure 10).

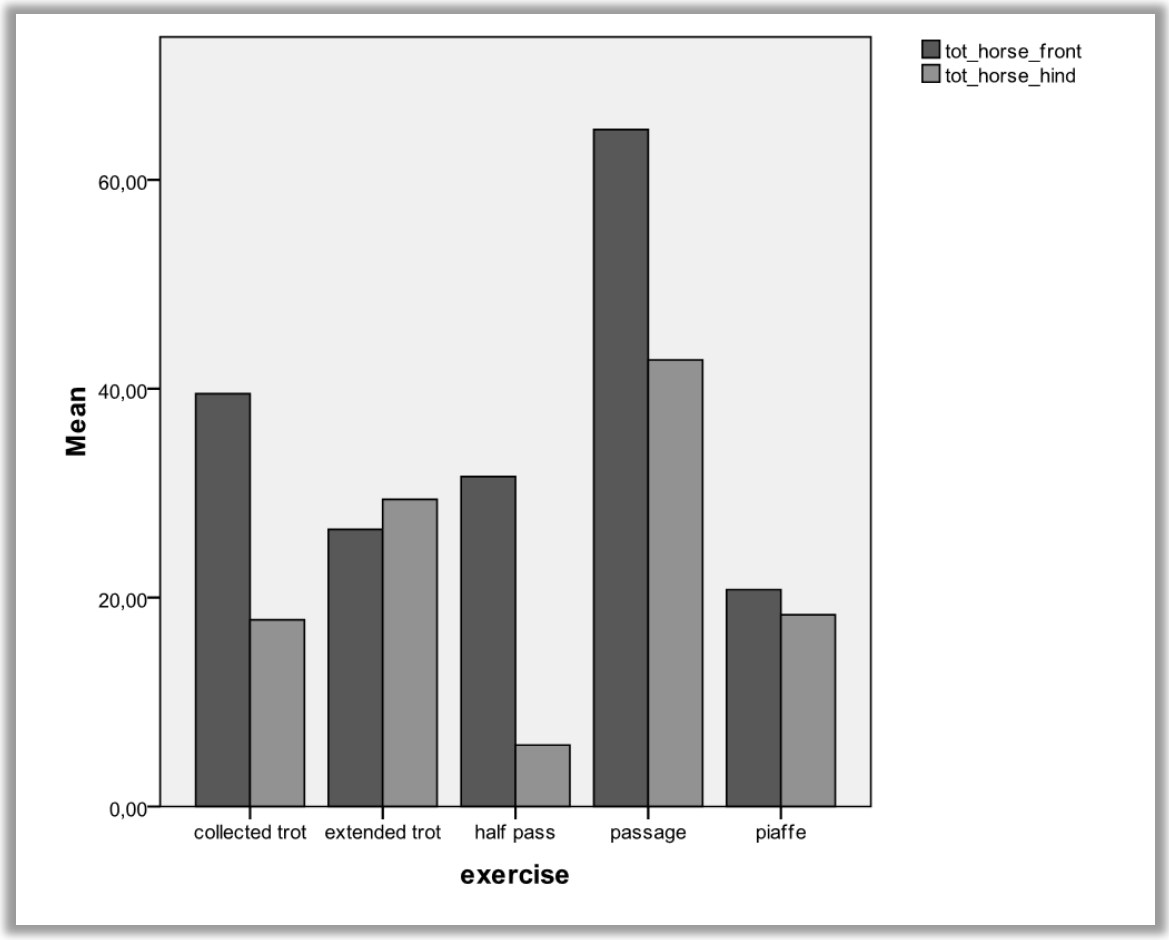


Figure 10 – fixations in correlation with exercises and front or hind part of the horse

5.5 Fixation count – Scores and total fixations

The correlation between the total fixations and the total score was tested using Pearson's Product Moment Correlation.

The Pearson correlation measure showed that there is no correlation between the total fixations and the total score given for the performances. The Pearson Correlation Coefficient was calculated to be 0.298[11]. The result was visualized with help of a scatter-dot-diagram (see figure 11).

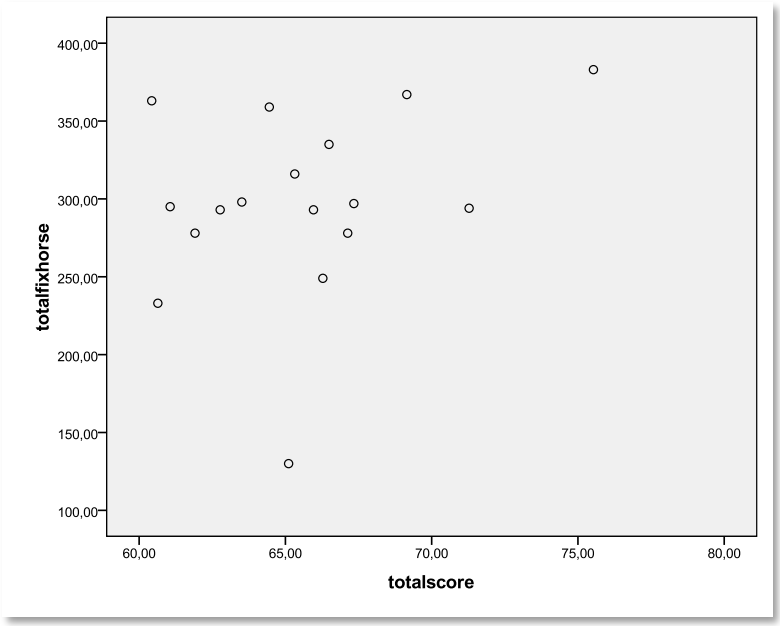


Figure 11 – correlation between total score and total fixations

[11] See Annex 10

6. Discussion

The aim of this study was to find out whether judges do have a certain strategy of visual search while evaluating a dressage performance. Therefore, looking at the areas of interest was essential in order to be able to analyse their behaviour. The use of an Eye Tracker was indispensable as this is a reliable method to show the actual fixations. Within the sample group a clear distinction in fixation areas was shown. Against the previous assumptions a solid majority of fixations on the front part of the horse was proven. The study of Binsch, O. et al (2009), for example, showed that professional golfers have a different perception than novice golfers. They proved that the hole appears bigger to advanced golfers showing that being an expert or professional changes your perception for certain visual factors. In case of golfers, this change of visual perception enables them to perform more precisely. Looking at the professional and very experienced dressage judges the assumption was near that they might have a different perception as well. If the objective size changes with the experience level, it might also be possible, that high level judges have a different perception of size or significance of single parts of the horse. And this is exactly what this study has started to show. The analysis showed that judges certainly focus more intensively on the fore-end, more precisely on the forearm of the horse. This is followed by the number of fixations on the shoulder and the cannon bone. Considering the hindquarters, the cannon bone and the lower leg is looked at most of the time. This means that numerous other parts of the horse-rider combination are ignored. The current research has shown clearly that professional judges do have the habit to look primarily on the front part of the horse in all exercises. The selection of areas of interest was assumed beforehand because the complexity of the information a judge has to process under conditions of extreme pressure and for long periods of time add up to a very demanding task for the judges. The evaluation of every single exercise within the performance is described in a very detailed manner in the judging regime,

meaning that judges are equipped with a vast list of elements to take into consideration. For instance, exercises that take about 8 seconds and include 15 paces, so as the passage, are endued with a total of 30 criteria that should be integrated in the judges' evaluation. This clearly shows how complex dressage judging is made and how many elements/criteria have to be recognized, evaluated and compared. The passage was proven to be the exercise which catches the most attention and fixations and it shows a clearly higher fixation number than the other exercises which might refer to the complexity of this exercise. In collected trot and half-pass a clear preference for the horses' front could be proven. Extended trot and piaffe showed a rather small difference of fixation count, nevertheless, a significant emphasis on the fore-end of the horse was proven. Compared to the vast list of evaluation criteria of the judging regime, it gets obvious that judges do not or maybe cannot check all the required elements defined in the system. It is important to realize that the judges might have been influenced in their evaluation by the video sequences, respectively the camera work. The viewing position does influence judging behavior as it was already shown in previous research on football referees (Oudejans et al, 2000) and on gymnastics (Plessner & Schallies, 2005) and the judges were not able to correct for potential biases resulting from the viewing position.

There is the possibility to interpret the situation from two different points of view. Either the judges are simply not able to consider all the criteria listed in the judging regime, due to reasons such as time, perception capability or information processing; or it could also be argued, whether professional judges do not consider other parts of the horse as relevant for their evaluation, which would create the need for further investigations. However, both ways clearly state the need for improvement concerning the judging rules. The current situation does leave much space for diverging judgments which might be one reason for distinct differences in the results. However, it is shown that judges do consciously or unconsciously

develop individual search strategies which allow them to reach the ‘right’ judgment by using short-cuts. This refers to the theory of ‘fast and frugal’ meaning to extract the needed information to be able to conduct the decision-making process. The complex judging task in dressage sports can only be possible with leaving out certain ‘dispensable’ information because time and processing ability are limited. The outcome of this research goes in line with the theory that judges need to rely on short-cuts as the given information cannot be processed totally. The fast and frugal heuristics state that good judges need to be able to extract the important information and this is exactly what the participants did. They filtered the information, picked out the relevant ones and were then able to come to a conclusion by using short-cuts.

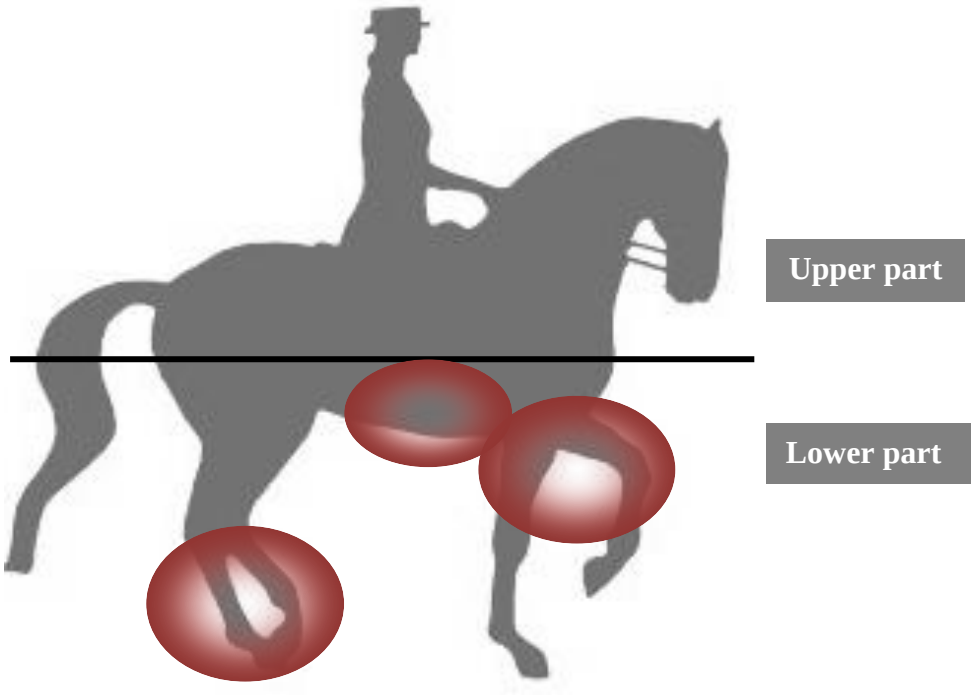
It is recommendable to conduct more research on the topic of visual search behavior in dressage judging as the current situation demands scientific proves in order to improve the judging processes. Looking at the results of the current study, it is advisable to conduct further research with a bigger sample size. This study was, due to time and practical possibilities, limited in its practicability and in order to make it more representative it is important to collect a bigger amount of data. Another aspect for further research would be to investigate the visual search behavior with a different videotape. The quality of the video presented for judging performances can influence the judging behavior and therefore it might be wise to conduct it with a video of higher visual quality. Factors like viewing position, optical sharpness and zoom would need further investigation and control and could lead to a more complete and detailed picture of the complete judging task. Another option would be to perform this research with a live performance for instance and then study the influencing effects of crowd noise, reputation of rider and/or horse and the real judging task performance

in addition to the current research questions. In general it is important to conduct more research on this topic in order to be able to get recommendations for changes in the judging system based on scientific proves and to close the gaps of assumptions and fill them with documented knowledge.

7. Conclusion

The outcome of the research enables the researcher to draw the following conclusions:

Professional judges on Grand Prix de Dressage level do show a certain visual search strategy, meaning that they mainly focus on the front part of the horse. Further analysis showed that most of the fixations were found on the forearm of the horse. As the analysis calculated significant differences between the body parts, it can be concluded that the horses' forearm is consciously or unconsciously considered to be the most important part to look at while evaluating a high-level dressage performance. The hindquarters of the horse showed a preference of the lower hind including the hoof, the pastern and the cannon bone. Analyzing the fixations on the rider, it got obvious that most of the fixations were found on the riders' lower leg. The three main areas of interest (forearm of the horse, lower leg of the rider and lower hind of the horse) showed that the judges mainly focus on the lower part of the horse-rider combination; the upper part of the athletes did not catch as much fixations.



The comparison of the different exercises collected and extended trot, half-pass, passage and piaffe the outcome of this study showed that most fixations were found in passage. The outcome of the comparison of all fixations with the total score given by the individual judges did not show a significant correlation. This means that there is no connection between the number of fixations and the final score and therefore the fixation rate does not influence the judges' grading.

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9. Appendices

Annex 1 – Evaluation Sheet Grand Prix 2009

GRAND PRIX

Event : _____ Date : _____ Judge : _____ Position ☐

Competitor No : ____ Name : _____ NF : ____ Horse : _____

Time 5'45" (for information only) Minimum age of horse : 8 years

		Test	Marks	Mark	Correction	Coefficient	Final mark	Directive ideas	Remarks
1.	A X XC	Enter in collected canter Halt - immobility - salute Proceed in collected trot Collected trot	10					Quality of paces, halt, and transitions. Straightness. Contact and poll.	
2.	C HXF FAK	Track to the left Extended trot Collected trot	10					Regularity, elasticity, balance, energy of hindquarters, overtrack. Lengthening of frame. Both transitions.	
3.	KB	Half-pass to the right	10			2		Regularity and quality of trot, uniform bend, collection, balance, fluency, crossing of legs.	
4.	BH HC	Half-pass to the left Collected trot	10			2		Regularity and quality of trot, uniform bend, collection, balance, fluency, crossing of legs.	
5.	C	Halt - immobility Rein back 5 steps and immediately proceed in collected trot	10					Quality of halt and transitions. Throughness, fluency, straightness. Accuracy in number of diagonal steps.	
6.	MV	Extended trot	10					Regularity, elasticity, balance, energy of hindquarters, overtrack. Lengthening of frame. Transition to extended trot.	
7.	VKD	Passage	10					Regularity, cadence, collection, self-carriage, balance, activity, elasticity of back and steps. Transition to passage.	
8.	D	Piaffe 12 to 15 steps	10					Regularity, taking weight, self-carriage, activity, elasticity of back and steps. Specific number of diagonal steps.	
9.	D	Transitions passage - piaffe - passage	10					Maintenance of rhythm, collection, self-carriage, balance, fluency, straightness. Precise execution.	
10.	DFP	Passage	10					Regularity, cadence, collection, self-carriage, balance, activity, elasticity of back and steps.	
11.	PH	Extended walk	10			2		Regularity, suppleness of back, activity, overtrack, freedom of shoulder, stretching to the bit. Transition into walk.	
12.	HCM	Collected walk	10			2		Regularity, suppleness of back, activity, shortening and heightening of steps, self-carriage.	
13.	M	Proceed in passage Transition collected walk - passage	10					Fluency, promptness, self-carriage, balance, straightness.	

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Annex 1 - proceeding

GRAND PRIX

Competitor No : ___ Name :_____ NF : _____ Horse : _____

		Test	Marks	Mark	Correction	Coefficient	Final mark	Directive ideas	Remarks
14.	MRI	Passage	10					Regularity, cadence, collection, self-carriage, balance, activity, elasticity of back and steps.	
15.	I	Piaffe 12 to 15 steps	10					Regularity, taking weight, self-carriage, activity, elasticity of back and steps. Specific number of diagonal steps.	
16.	I	Transitions passage - piaffe - passage	10					Maintenance of rhythm, collection, self-carriage, balance, fluency, straightness. Precise execution.	
17.	ISE	Passage	10					Regularity, cadence, collection, self-carriage, balance, activity, elasticity of back and steps.	
18.	E EKAF	Proceed in collected canter left Collected canter	10					Precise execution and fluency of transition. Quality of canter.	
19.	FXH HCM	On the diagonal 9 flying changes of leg every 2nd stride Collected canter	10					Correctness, balance, fluency, uphill tendency, straightness. Quality of canter before and after.	
20.	MXK	Extended canter	10					Quality of canter, impulsion, lengthening of strides and frame. Balance, uphill tendency, straightness.	
21.	K KA	Collected canter and flying change of leg Collected canter	10					Quality of flying change on diagonal. Precise, smooth execution of transition.	
22.	A Between D & G G C	Down the centre line 5 half-passes to either side of centre line with flying change of leg at each change of direction, the first half-pass to the left and the last to the left of 3 strides, the others of 6 strides Flying change of leg Track to the right	10			2		Quality of canter. Uniform bend, collection, balance, fluency from side to side. Symmetrical execution. Quality of flying changes.	
23.	MXK KA	On the diagonal 15 flying changes of leg every stride Collected canter	10			2		Correctness, balance, fluency, uphill tendency, straightness. Quality of canter before and after.	
24.	A L	Down the centre line Pirouette to the left	10			2		Collection, self-carriage, balance, size, flexion and bend. Correct number of strides (6-8). Quality of canter before and after.	
25.	X	Flying change of leg	10					Correctness, balance, fluency, uphill tendency, straightness. Quality of canter before and after.	
26.	I C	Pirouette to the right Track to the right	10			2		Collection, self-carriage, balance, size, flexion and bend. Correct number of strides (6-8). Quality of canter before and after.	
27.	M MR	Transition to collected trot Collected trot	10					Fluency; precise, smooth execution of transition.	
28.	RK KA	Extended trot Collected trot	10					Regularity, elasticity, balance, energy of hindquarters, overtrack. Lengthening of frame. Both transitions.	

D-GP09-2009 - page 2

Annex 1 - proceeding

GRAND PRIX

Competitor No : ___ Name :_____ NF : _____ Horse : _____

		Test	Marks	Mark	Correction	Coefficient	Final mark	Directive ideas	Remarks
29.	A DX	Down the centre line Passage	10					Regularity, cadence, collection, self-carriage, balance, activity, elasticity of back and steps. Transition to passage.	
30.	X	Piaffe 12 to 15 steps	10					Regularity, taking weight, self-carriage, activity, elasticity of back and steps. Specific number of diagonal steps.	
31.	X	Transitions passage - piaffe - passage	10					Maintenance of rhythm, collection, self-carriage, balance, fluency, straightness. Precise execution.	
32.	XG	Passage	10					Regularity, cadence, collection, self-carriage, balance, activity, elasticity of back and steps.	
33.	G	Halt - immobility - salute	10					Quality of halt and transition. Straightness. Contact and poll.	
		Leave arena at A in walk on a long rein							
		Total	**410**						

Collective mark

1.	Paces (freedom and regularity)	10			1	General Remarks:
2.	Impulsion (desire to move forward, elasticity of the steps, suppleness of the back and engagement of the hind quarters)	10			1	
3.	Submission (attention and confidence; harmony, lightness and ease of the movements; acceptance of the bridle and lightness of the forehand)	10			2	
4.	Rider's position and seat; correctness and effect of the aids	10			2	
	Total	**470**				

To be deducted / penalty points

Errors of course (Art 430.6.1) are penalised

1st error = 2 points

2nd error = 4 points

3rd error = Elimination

Two (2) points to be deducted per other error.

Please see Art 430.6.2

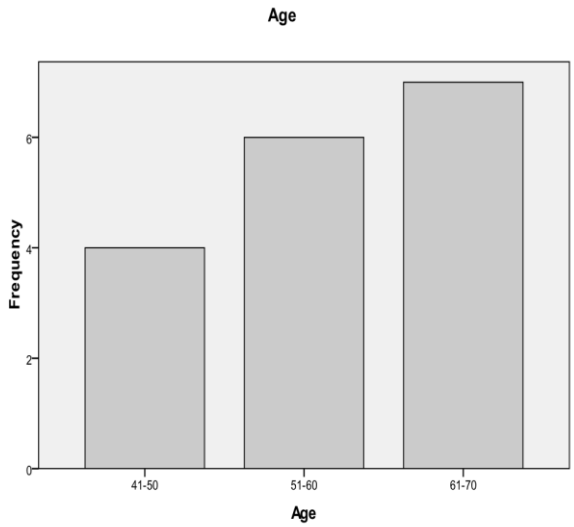
TOTAL | **TOTAL SCORE in %:**

Organisers :
(exact address)

Signature of Judge :

Annex 2 – descriptive statistics

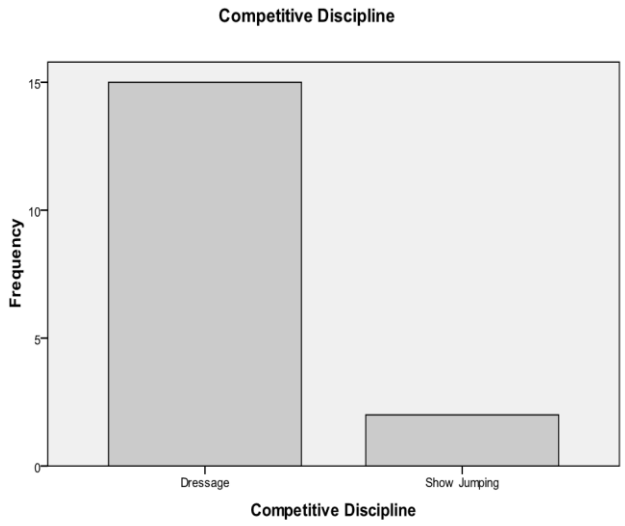
Annex 2.1 – bar chart and analysis report of age distribution



Age

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	41-50	4	4,7	23,5	23,5
	51-60	6	7,1	35,3	58,8
	61-70	7	8,2	41,2	100,0
	Total	17	20,0	100,0	
Missing	System	68	80,0		
Total		85	100,0		

Annex 2.2 – distribution and analysis report of the competitive discipline of the judges



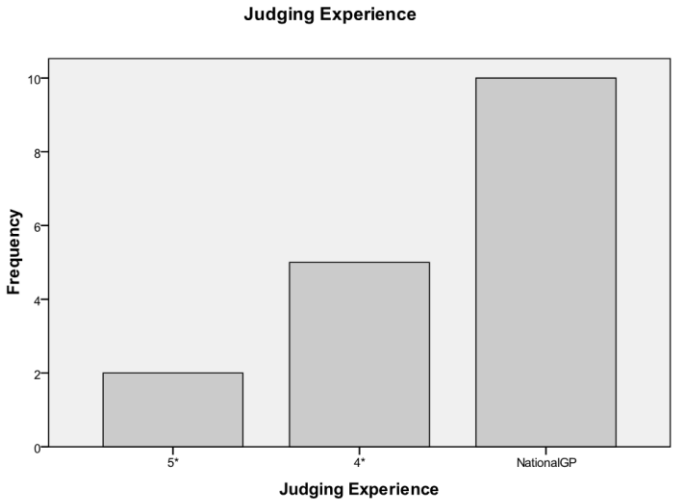
Competitive Discipline

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Dressage	15	17,6	88,2	88,2
	Show Jumping	2	2,4	11,8	100,0
	Total	17	20,0	100,0	
Missing	System	68	80,0		
Total		85	100,0		

Annex 2.3 – distribution of judging experience level

Judging Experience

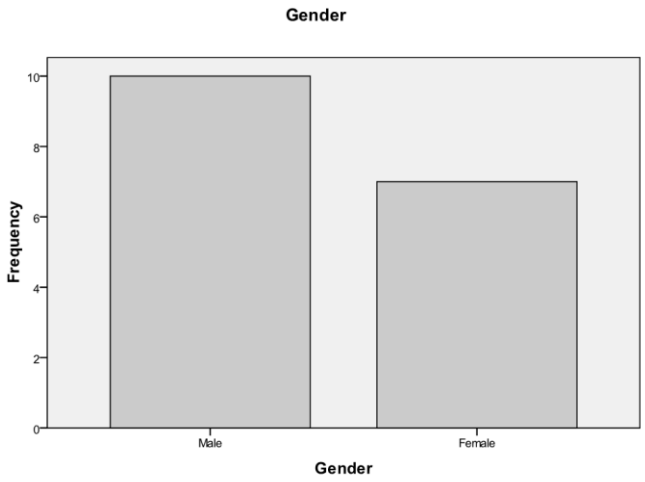
		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	5*	2	2,4	11,8	11,8
	4*	5	5,9	29,4	41,2
	National GP	10	11,8	58,8	100,0
	Total	17	20,0	100,0	
Missing	System	68	80,0		
Total		85	100,0		



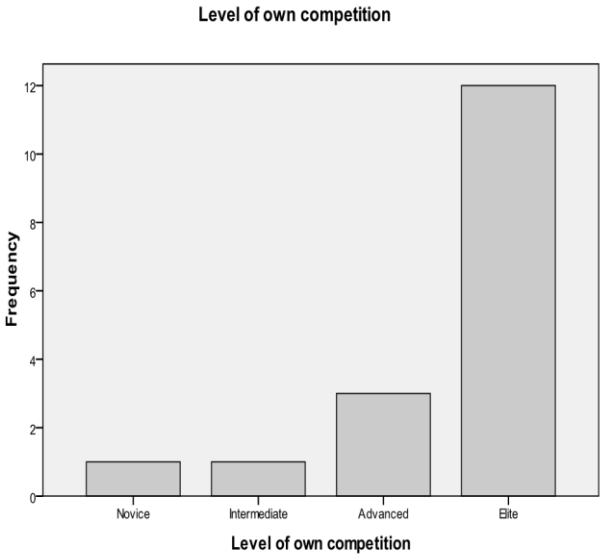
Annex 2.4 – distribution of gender

Gender

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Male	10	11,8	58,8	58,8
	Female	7	8,2	41,2	100,0
	Total	17	20,0	100,0	
Missing	System	68	80,0		
Total		85	100,0		



Annex 2.5 – distribution of competition levels



Level of own competition

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	Novice	1	1,2	5,9	5,9
	Intermediate	1	1,2	5,9	11,8
	Advanced	3	3,5	17,6	29,4
	Elite	12	14,1	70,6	100,0
	Total	17	20,0	100,0	
Missing	System	68	80,0		
Total		85	100,0		

Annex 2.6 – years of judging in total

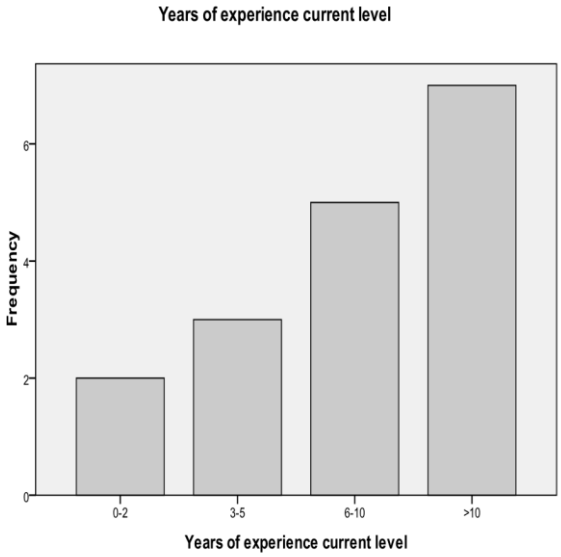
Years of judging

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	>20	17	20,0	100,0	100,0
Missing	System	68	80,0		
Total		85	100,0		

Annex 2.7 – years of judging on current level

Years of experience current level

		Frequency	Percent	Valid Percent	Cumulative Percent
Valid	0-2	2	2,4	11,8	11,8
	3-5	3	3,5	17,6	29,4
	6-10	5	5,9	29,4	58,8
	>10	7	8,2	41,2	100,0
	Total	17	20,0	100,0	
Missing	System	68	80,0		
Total		85	100,0		



Annex 3 – table of fixation count

		horse - fore end -									
	exercises	**head**	**mouth**	**poll**	**neck**	**shoulder**	**forearm**	**knee**	**cannon+lower**	**breast**	**tot**
XC	collected trot										
HXF	extended trot										
FAK	collected trot										
KB	half-pass right										
BH	half-pass left										
HC	collected trot										
MV	extended trot										
VKD	passage										
D	piaffe										
DFP	passage										
MRI	passage										
I	piaffe										
ISE	passage										
MR	collected trot										
RK	extended trot										
KA	collected trot										
DX	passage										
X	piaffe										
XG	passage										
TOTAL											

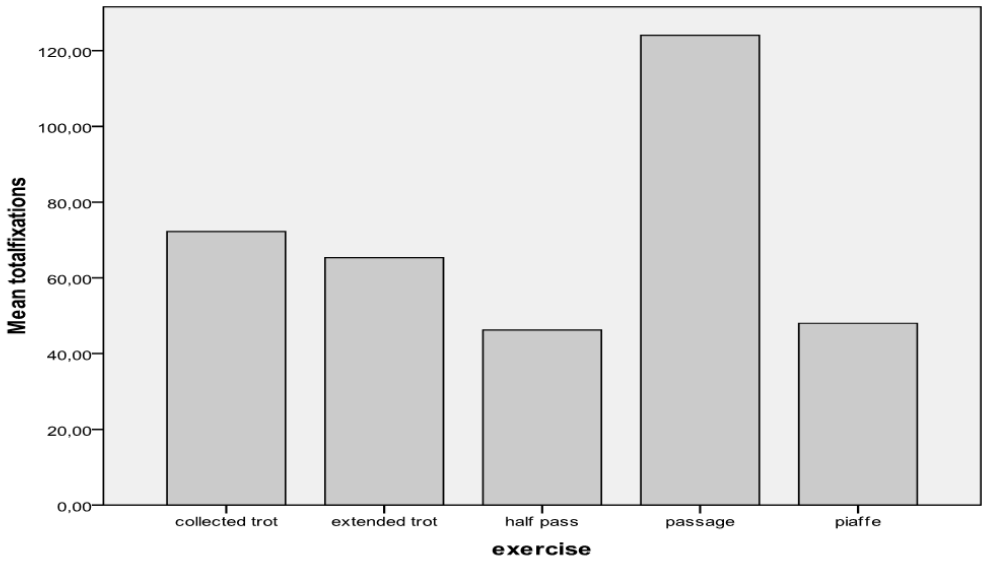
		horse - hindquarters							
	exercises	**croup**	**tail**	**thigh**	**flank**	**lower leg**	**hock**	**cannon+lower**	**total**
XC	collected trot								
HXF	extended trot								
FAK	collected trot								
KB	half-pass right								
BH	half-pass left								
HC	collected trot								
MV	extended trot								
VKD	passage								
D	piaffe								
DFP	passage								
MRI	passage								
I	piaffe								
ISE	passage								
MR	collected trot								
RK	extended trot								
KA	collected trot								
DX	passage								
X	piaffe								
XG	passage								
TOTAL									

Annex 3 – proceeding

		rider						
	exercises	**head**	**torso**	**hand**	**thigh**	**knee**	**lower leg**	**total**
XC	collected trot							
HXF	extended trot							
FAK	collected trot							
KB	half-pass right							
BH	half-pass left							
HC	collected trot							
MV	extended trot							
VKD	passage							
D	piaffe							
DFP	passage							
MRI	passage							
I	piaffe							
ISE	passage							
MR	collected trot							
RK	extended trot							
KA	collected trot							
DX	passage							
X	piaffe							
XG	passage							
TOTAL								

Annex 4

Mean of fixations and the different exercises



Descriptive Statistics

exercise		N	Minimum	Maximum	Mean	Std. Deviation
collected trot	totalfixations	17	26,00	119,00	72,2353	21,56539
	Valid N (listwise)	17				
extended trot	totalfixations	17	36,00	85,00	65,3529	11,80011
	Valid N (listwise)	17				
half pass	totalfixations	17	27,00	60,00	46,2353	9,05904
	Valid N (listwise)	17				
passage	totalfixations	17	48,00	183,00	124,0588	29,34380
	Valid N (listwise)	17				
piaffe	totalfixations	17	11,00	110,00	48,0000	20,75452
	Valid N (listwise)	17				

Annex 5 – Significance test for 3 factors

Within-Subjects Factors

Measure:MEASURE_1

Faktor1	Dependent Variable
1	tothorsefront
2	tot_horse_hind
3	tot_rider

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Faktor1	Pillai's Trace	,913	78,604[a]	2,000	15,000	,000
	Wilks' Lambda	,087	78,604[a]	2,000	15,000	,000
	Hotelling's Trace	10,480	78,604[a]	2,000	15,000	,000
	Roy's Largest Root	10,480	78,604[a]	2,000	15,000	,000

Pairwise Comparisons

Measure:MEASURE_1

(I) Faktor1	(J) Faktor1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	68,765*	10,381	,000	46,758	90,772
	3	128,412*	10,038	,000	107,133	149,691
2	1	-68,765*	10,381	,000	-90,772	-46,758
	3	59,647*	8,686	,000	41,234	78,060
3	1	-128,412*	10,038	,000	-149,691	-107,133
	2	-59,647*	8,686	,000	-78,060	-41,234

Annex 6 – fixation count on single body parts of the horse

front

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
head	17	2,00	36,00	14,2353	10,97457
mouth	17	6,00	46,00	19,5882	9,91248
poll	17	,00	29,00	3,5882	6,99159
shoulder	17	17,00	51,00	34,1765	11,89136
neck	17	1,00	60,00	18,0000	15,23565
forearm	17	18,00	88,00	42,2353	16,64906
cannon	17	6,00	76,00	28,1765	18,56824
knee	17	2,00	45,00	14,9412	10,55622
breast	17	2,00	13,00	8,2941	3,33100
Valid N (listwise)	17				

hindquarters

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
croup	17	,00	16,00	3,9412	4,19032
tail	17	2,00	12,00	5,2941	3,07743
thigh	17	,00	16,00	7,7059	5,07155
flank	17	2,00	26,00	8,3529	5,91546
lowerleg	17	6,00	43,00	23,8235	10,61388
hock	17	4,00	23,00	11,3529	5,41919
lowerhind	17	11,00	131,00	54,0000	29,57829
Valid N (listwise)	17				

Annex 6 - proceeding

rider

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
head_rider	17	,00	10,00	2,4706	2,89650
torso_rider	17	,00	14,00	5,2353	4,46555
hand_rider	17	,00	15,00	3,3529	4,62252
thigh_rider	17	,00	31,00	8,0000	7,54155
knee_rider	17	1,00	22,00	8,1176	5,30191
lowerleg_rider	17	8,00	54,00	27,6471	13,53671
Valid N (listwise)	17				

Annex 7 – Fixation count within exercises

Descriptive Statistics

exercise		N	Minimum	Maximum	Mean	Std. Deviation
collected trot	totalfixations	17	26,00	119,00	72,2353	21,56539
	Valid N (listwise)	17				
extended trot	totalfixations	17	36,00	85,00	65,3529	11,80011
	Valid N (listwise)	17				
half pass	totalfixations	17	27,00	60,00	46,2353	9,05904
	Valid N (listwise)	17				
passage	totalfixations	17	48,00	183,00	124,0588	29,34380
	Valid N (listwise)	17				
piaffe	totalfixations	17	11,00	110,00	48,0000	20,75452
	Valid N (listwise)	17				

Annex 8 – difference between exercises

Within-Subjects Factors

Measure:MEASURE_1

Faktor1	Dependent Variable
1	collected
2	extended
3	half_pass
4	passage
5	piaffe

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Faktor1	Pillai's Trace	,956	70,977[a]	4,000	13,000	,000
	Wilks' Lambda	,044	70,977[a]	4,000	13,000	,000
	Hotelling's Trace	21,839	70,977[a]	4,000	13,000	,000
	Roy's Largest Root	21,839	70,977[a]	4,000	13,000	,000

Pairwise Comparisons

(I) Faktor1	(J) Faktor1	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	6,882	4,784	,170	-3,260	17,024
	3	26,000*	4,611	,000	16,226	35,774
	4	-51,824*	6,994	,000	-66,651	-36,996
	5	28,000*	4,740	,000	17,953	38,047
2	1	-6,882	4,784	,170	-17,024	3,260
	3	19,118*	3,220	,000	12,292	25,943
	4	-58,706*	5,673	,000	-70,732	-46,680
	5	21,118*	2,602	,000	15,601	26,634
3	1	-26,000*	4,611	,000	-35,774	-16,226
	2	-19,118*	3,220	,000	-25,943	-12,292
	4	-77,824*	6,781	,000	-92,199	-63,448
	5	2,000	3,216	,543	-4,819	8,819
4	1	51,824*	6,994	,000	36,996	66,651
	2	58,706*	5,673	,000	46,680	70,732
	3	77,824*	6,781	,000	63,448	92,199
	5	79,824*	4,991	,000	69,244	90,403
5	1	-28,000*	4,740	,000	-38,047	-17,953
	2	-21,118*	2,602	,000	-26,634	-15,601
	3	-2,000	3,216	,543	-8,819	4,819
	4	-79,824*	4,991	,000	-90,403	-69,244

Annex 9 - Correlation between parts of the horses' body and the exercises

One-Sample Test

		Test Value = 0					
						95% Confidence Interval of the Difference	
exercise		t	df	Sig. (2-tailed)	Mean Difference	Lower	Upper
collected trot	horse_front	14,570	16	,000	39,52941	33,7778	45,2810
	horse_hind	10,548	16	,000	17,88235	14,2884	21,4763
	Rider_tot	8,318	16	,000	14,76471	11,0017	18,5277
extended trot	horse_front	10,668	16	,000	26,52941	21,2574	31,8014
	horse_hind	20,139	16	,000	29,41176	26,3158	32,5077
	Rider_tot	8,300	16	,000	9,17647	6,8327	11,5202
half pass	horse_front	21,338	16	,000	31,58824	28,4499	34,7266
	horse_hind	5,477	16	,000	5,88235	3,6055	8,1592
	Rider_tot	8,023	16	,000	8,17647	6,0161	10,3368
passage	horse_front	13,645	16	,000	64,82353	54,7528	74,8943
	horse_hind	11,494	16	,000	42,76471	34,8776	50,6518
	Rider_tot	7,926	16	,000	17,70588	12,9699	22,4418
piaffe	horse_front	9,598	16	,000	20,76471	16,1785	25,3509
	horse_hind	10,383	16	,000	18,35294	14,6057	22,1002
	Rider_tot	6,464	16	,000	4,94118	3,3207	6,5617

Annex 9 - proceeding

Correlation between exercise and front

exercise		head	mouth	poll	neck	shoulder	forearm	knee	cannon	breast
collected trot	Mean	3,1176	4,2353	,8824	5,9412	8,8235	8,6471	2,1765	4,2353	1,4706
	N	17	17	17	17	17	17	17	17	17
	Std. Deviation	3,15995	2,70484	1,36393	5,34405	3,48632	4,44327	2,40404	3,50944	1,06757
extended trot	Mean	2,0000	2,9412	,6471	3,1765	4,4706	5,8824	1,7059	5,5882	,1176
	N	17	17	17	17	17	17	17	17	17
	Std. Deviation	2,00000	2,24918	1,27187	2,81148	2,67202	4,22614	1,86295	4,25821	,33211
half pass	Mean	5,4118	5,6471	,8824	2,4706	5,5882	5,7647	1,7059	1,4118	2,7059
	N	17	17	17	17	17	17	17	17	17
	Std. Deviation	4,54228	3,44495	1,31731	2,06512	3,16344	3,32659	2,02376	2,03282	1,44761
passage	Mean	3,4118	5,7059	1,0000	5,3529	11,9412	15,7059	6,4706	12,1176	3,1176
	N	17	17	17	17	17	17	17	17	17
	Std. Deviation	3,67524	4,57937	3,62284	5,56710	5,79300	7,39734	5,10046	7,84126	2,28808
piaffe	Mean	,3529	1,0588	,1765	1,0588	3,4118	6,1176	2,8824	4,8235	,8824
	N	17	17	17	17	17	17	17	17	17
	Std. Deviation	,70189	1,34493	,52859	1,43486	1,97037	3,38900	2,26060	4,40504	,92752
Total	Mean	2,8588	3,9176	,7176	3,6000	6,8471	8,4235	2,9882	5,6353	1,6588
	N	85	85	85	85	85	85	85	85	85
	Std. Deviation	3,47492	3,47512	1,90620	4,16962	4,75471	6,03635	3,42433	5,88551	1,74951

Annex 9 - proceeding

Correlation between exercises and back

Report

exercise		croup	thigh	tail	flank	lowerleg	hock	lowerhind
collected trot	Mean	,8824	1,5294	,4706	2,5882	4,2353	1,3529	6,8235
	N	17	17	17	17	17	17	17
	Std. Deviation	1,16632	1,46277	,71743	2,73995	2,88378	1,05719	5,28246
extended trot	Mean	1,8824	3,8824	3,5294	2,0588	5,4706	2,8235	9,7647
	N	17	17	17	17	17	17	17
	Std. Deviation	1,69124	2,36861	2,52779	1,67595	2,76400	2,53069	6,53385
half pass	Mean	,1765	,5882	,0588	,2353	1,9412	,3529	2,5294
	N	17	17	17	17	17	17	17
	Std. Deviation	,52859	1,06412	,24254	,56230	1,88648	,60634	3,08459
passage	Mean	,8235	1,3529	1,1176	2,5294	8,8824	4,7059	23,3529
	N	17	17	17	17	17	17	17
	Std. Deviation	1,38000	1,90201	1,05370	2,89650	5,51002	2,80100	12,89351
piaffe	Mean	,0000	,3529	,1176	,9412	3,2941	2,1176	11,5294
	N	17	17	17	17	17	17	17
	Std. Deviation	,00000	,60634	,33211	,96635	2,82322	1,79869	5,92788
Total	Mean	,7529	1,5412	1,0588	1,6706	4,7647	2,2706	10,8000
	N	85	85	85	85	85	85	85
	Std. Deviation	1,29013	2,00922	1,80180	2,16239	4,08145	2,40727	10,14279

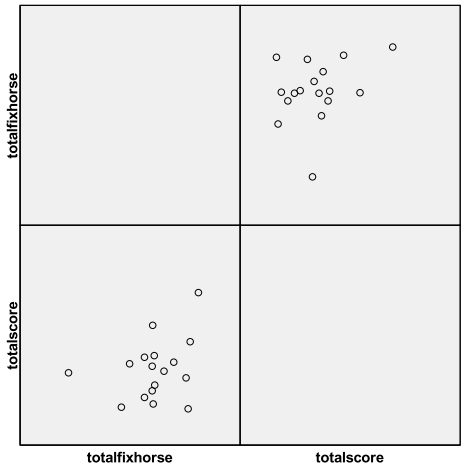
Annex 9 - proceeding

Correlation between exercises and rider

Report

exercise		headrider	torsorider	handrider	thighrider	kneerider	lowerlegrider
collected trot	Mean	,9412	1,9412	1,1176	3,0000	2,1765	5,5882
	N	17	17	17	17	17	17
	Std. Deviation	1,47778	2,27680	1,99632	3,02076	1,70423	3,48315
extended trot	Mean	,1176	,8235	,3529	1,2353	1,6471	5,0000
	N	17	17	17	17	17	17
	Std. Deviation	,33211	1,13111	,60634	1,34766	1,65609	2,69258
half pass	Mean	,5294	,8824	,7647	1,6471	1,7647	2,5882
	N	17	17	17	17	17	17
	Std. Deviation	,94324	1,05370	1,03256	1,96663	1,82104	2,62342
passage	Mean	,7059	1,2941	,9412	2,0000	2,2353	10,5294
	N	17	17	17	17	17	17
	Std. Deviation	,91956	1,64942	1,43486	2,31840	2,58673	6,40427
piaffe	Mean	,1765	,2941	,1765	,1176	,2353	3,9412
	N	17	17	17	17	17	17
	Std. Deviation	,39295	,58787	,39295	,48507	,56230	2,56102
Total	Mean	,4941	1,0471	,6706	1,6000	1,6118	5,5294
	N	85	85	85	85	85	85
	Std. Deviation	,94647	1,52679	1,25725	2,18872	1,89042	4,63061

Annex 10 – correlation between total score and fixations



Correlations

		totalscore	totalfixhorse
totalscore	Pearson Correlation	1	,298
	Sig. (2-tailed)		,246
	N	17	17
totalfixhorse	Pearson Correlation	,298	1
	Sig. (2-tailed)	,246	
	N	17	17