Visual Attention in Dressage Judges

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1. ABSTRACT

The sports of dressage with its subjective judging system is prone to discussions about objectivity and possible biases of judges. Reasons for these discrepancies are not fully understood yet, therefore this research investigated visual attention in Grand Prix dressage judges with the goal of finding potential differences and possibly reasons for these differences. The study aimed at finding patterns of visual attention in dressage judges and especially differences in these patterns, which might explain differences in the given scores.

The results of the research showed a relatively consistent pattern of visual attention, with judges focusing significantly more on the forehand than on the hindquarters, and even significantly less on the rider. Due to this consistency, this research could not point out reasons for differences between judges. Further research, however, should be done making use of these results to investigate differences between judges of remarkably different experience levels. Assuming that differences between very different experience levels will be significant, these results could then be used to improve the education of novice judges by enabling them to learn from the expert judges' patterns of visual attention.

2. INTRODUCTION

Dressage is one of the most popular equestrian sports and also one of the three equestrian disciplines at the Olympic games. In dressage, a horse-rider combination has to perform a prescribed sequence of movements which is the same for all participants, with exception of the freestyle. The performance is evaluated by judges giving a mark for each performed movement. These marks are then added up to calculate the final mark for each participant.

As in several other sports, judging in dressage is subjective. It does not rely on measurable aspects as for example time in running or falling poles in show jumping, but judges give marks for each movement according to their personal impressions. Due to this judging system, differences between judges' scores occur. Therefore discussions about objectivity of judges and potential biases arise frequently. The Fédération Equestre Internationale (FEI) recently started to investigate opportunities to make the judging system more objective, for example by placing seven judges around the arena instead of five and disregarding the highest and lowest of these seven scores for the final mark. However, these changes were also not able to ensure more consistent judgment. Up to now, no proven reasons for differences between dressage judges could be pointed out either. Therefore, this research will point out possible patterns of visual attention in dressage judges, but also especially points for further research and investigation to find reasons for differences between judges.

This research investigates what a Grand Prix judge actually looks at when evaluating the performance of a horse-rider combination, focusing on the gaits of walk and canter. The actual objective of this research is to investigate patterns of visual attention in judges when judging a Grand Prix test. More specifically, the focus of visual attention on different body parts of the horse and rider will be studied, and potential differences between groups of judges will be compared, so that reasons for discrepancies in scores between judges might become more clear.

The main question to be answered by this research therefore is what a dressage judge focuses his visual attention on when evaluating the performance of a horse-rider combination. Other questions which will be answered are whether there are significant differences in visual attention focus between different body parts for the different movements being performed; whether there are significant differences between judges of national and international level, and whether there is a correlation between the number of fixations and the given score.

3. LITERATURE REVIEW

3.1 INTRODUCTION

When judging the performance of a horse-rider combination, the judge needs to perceive some information about the performance and process it. The information is evaluated using previously gained knowledge and a decision on the quality of the performance is made which is expressed by the given mark.

According to Plessner and Haar (2006), judging in sports follows the same information processing framework as other social cognition tasks. The steps of this framework are perception, encoding and categorization, memory processes and finally integration of information. The first step, perception, describes the actual perception of a stimulus, in case of this research a judge seeing a dressage performance. The second step, encoding and categorization, means the definition of the perceived stimulus, in dressage judging for example defining a movement as piaffe or half-pass. The third step then activates information stored in memory which is related to the stimulus, so for dressage judging the criteria related to the seen task would be retrieved from memory. The final step includes the information retrieved from memory and the information from the perceived stimulus, so that an appropriate judgment can be formed which usually is expressed as a decision. In dressage sports, this would mean the comparison of the perceived performance to the criteria stored in memory, so that an appropriate mark can be given for the perceived task.

3.2 DRESSAGE JUDGING

Before reviewing the details of the cognitive processes in dressage judging, some general description of dressage sports and the judging system will improve understanding of the further information. In dressage competitions, riders present their horses in prescribed sequences of movements which is the same for each participant of a test. Five judges placed around the arena give marks for each of the prescribed movements. This method however does cause discussions because of the subjective score given by the judges (Peham *et al*., 2001).

Judging in dressage is based on the criteria of the FEI. For each movement there are several criteria which actually cannot all be assessed by each judge in the short time of the specific movement. Therefore the question arises at what the judges actually do look to evaluate the performance of a horse-rider combination. To improve the method of judging, studies have been done to quantify the evaluation of horse-rider performance. For example, motion pattern consistency, which is said to be a main characteristic of riding harmony, was analyzed by Peham *et al.* (2001). Unfortunately, their method, using markers on horse and riders, would be quite impractical as an option to simplify judging in practice due to the required markers.

Riding is a very complex movement due to the different factors of horse and rider and also external factors influencing the movements. However, it has been shown that the majority of variances of movement in trot can be described mainly by only one order parameter and those in walk and canter can be described by only two (Witte *et al*., 2009). This implies that it should be investigated if the criteria for judging could be reduced to less criteria which are of major relevance.

3.3. THE GAITS

In dressage, horses have to show different movements in three different gaits. These gaits are walk, trot and canter. As this research focuses on walk and canter, these will be described in detail.

3.3.1. WALK

Walk is a four-time beat in eight phases. It begins with a hind triple stance where the left foreleg and both hind legs are on the ground, then the left hind leg lifts off and leads to the right diagonal double stance with right hind and left foreleg on the ground. After the right foreleg touched ground, fore triple stance occurs with right hind leg and both forelegs having ground contact. Lifting off the left foreleg begins right lateral double stance with right hind and foreleg on the ground before the left hind leg also touches ground leading to hind triple stance. Right hind leg then lifts off leading to left diagonal double stance. Left foreleg sets down to start the fore triple stance before finally the right foreleg lifts off and left lateral stance occurs (Pilliner *et al*, 2002). At all times, two or three legs have ground contact.

Walk should have a regular and clear four-beat rhythm with even, not constrained strides. Same length and duration of strides is very important (FN, 1997). It is also important that the rider allows for the horse’s natural movement of the neck so that the horse can walk unrestrictedly (FN, 2005; KNHS, 2006). Over tracking, which means that the hind foot hits the ground in front of the ipsilateral forefoot, depends on the variation of walk between collected, medium and extended walk.

In dressage, there is collected, medium and extended walk. Medium walk basically is the horse’s natural walk, with the hind legs over tracking. Collected walk is distinguished by a shorter length of each stride and no over tracking, while extended walk is characterized by longer, ground covering strides and clearly more over tracking than in medium walk (FN, 1997). Major mistakes that are frequently seen in dressage tests in walk are especially ipsilateral movement of foreleg and hind leg, disrupting the clear four-beat of walk. When observing a horse in walk, a clear “V” should be seen when the foreleg starts lifting off while the ipsilateral hind leg touches ground (FN, 1997). Another major mistake is the irregular movement of the hind legs, one doing a shorter stride than the other. Both mistakes are often caused by rider influence (FN, 1997).

Although there are medium, extended and collected walk, as well as several exercises performed in walk, like pirouettes, only collected and extended walk are evaluated by the judges at Grand Prix level.

3.3.2 CANTER

Canter is a three-time beat in six phases. It is an asymmetrical movement; either the left or the right foreleg is leading, therefore left and right canter can be distinguished.

Right canter starts with the trailing hind single stance, meaning that only the left hind leg has ground contact. After the diagonal of right hind leg and left foreleg touched the ground simultaneously, hind tripedal stance occurs before the left hind leg lifts off and thus leads to right diagonal double stance. The right, leading, foreleg then hits the ground and fore tripedal stance occurs. Then the diagonal of left foreleg and right hind leg lifts off leading to lead fore single stance, before the right leading foreleg also pushes off the ground and suspension phase begins (Pilliner *et al*, 2002).In left canter, the horse moves its legs just the other way round, with the left foreleg leading. Footfall sequence therefore is right hind, left hind and right foreleg together, left leading foreleg and suspension phase.

Canter should be in a regular and clear three-beat rhythm with a clearly defined suspension phase. The horse should stay straight, not moving its hindquarters to the side. Uphill tendency is desired, meaning that the horse gives the impression to an observer that it is cantering uphill; with the withers higher than the croup.

In dressage, canter is ridden as collected canter, working canter, medium canter and extended canter. Working canter should be regular with a ground cover of about one horse length. Medium canter should have more ground cover, while extended canter should lead to maximum ground cover. In both medium and extended canter the strides should become longer, not hurried. Collected canter is characterized by a more elevated, shorter stride due to the horse’s center of gravity being shifted towards the hindquarters (FN, 1997). In dressage tests, also flying changes of lead are required. Horses change the leading leg during the suspension phase of the canter then (Pilliner *et al*, 2002).

A mistake which can frequently be observed in dressage is a four-beat canter, in which the diagonal pair of legs does not touch the ground simultaneously anymore. It is often caused by too strong influence of the reins (FN, 1997).

Tasks ridden in canter which are evaluated at Grand Prix level are collected and extended canter, canter pirouettes, half passes and flying changes.

3.4 PERCEPTION

After having reviewed the details of the judging system in dressage, the focus will now shift to the cognitive processes involved in judging in sports.

Concerning the first step of the information processing framework, which is perception, it would be ideal if all relevant information could be perceived and passed on to the processing system (Plessner and Haar, 2006). However, due to the limited capacities of the brain, humans cannot process all the visual information available on the retina (Duncan and Humphreys, 1989). Therefore, all the available information has to compete for analysis, as available capacities have to be distributed to a few selected tasks (Eriksen and St. James, 1986). Visual attention must focus on the most relevant information. Information which is not relevant for current requirements is often not even perceived, as it is filtered out quite early in the process of visual perception (Desimone and Duncan, 1995). It is possible to distribute the brain’s capacities varyingly from even distribution over a large region of the visual field but perceiving very little detail to focusing on one point and perceiving this point in depth (Eriksen and St. James, 1986). This focusing would occur within the foveal and parafoveal areas of the visual field, as in other parts the retina is not able to provide sufficient detail (Eriksen and St. James, 1986).

Perception works in a way that first only single aspects of an object are perceived which are later combined to form conjunction information about each object (Duncan and Humphreys, 1989). The more closely related target information and distractors are, the smaller the area on which one focuses visual attention must be. Usually, in the visual field there is a huge amount of irrelevant information which must be ignored to search efficiently for desired information within the visual field (Duncan and Humphreys, 1989).

A dressage judge therefore needs to know which body parts of the horse are most important for each task during the dressage test, as it has to be known where important cues can be found to allocate attention appropriately in sports (Plessner and Haar, 2006). Visual attention needs to be focused on these relevant body parts to ensure enough details can be provided for further processing.

3.5 THE BRAIN'S INVOLVEMENT

The brain areas which are related to processing of visual stimuli are especially the inferior temporal cortex, with the so-called ventral stream leading to it, which is mostly related to object recognition. The posterior parietal cortex with the dorsal stream leading towards it is in contrast related to spatial perception (Desimone and Duncan, 1995). The ventral stream passes on information about the location of objects on the retina. As capacity of the ventral stream is limited, objects must already compete for further processing at this location. Some parallel processing of objects is possible, but the more objects need to be processed, the less information is available on each object due to the capacity limitations Basically, the same is valid for the dorsal stream analyzing the spatial properties of perceived objects (Desimone and Duncan, 1995).

For the process of judging a dressage performance, especially object recognition and thus the ventral stream is important. To ensure that the eye is moved in a way enabling to focus on relevant parts of the horse’s body, the brain needs information about the location of relevant points.

Visual stimuli are at first sent to both brain hemispheres for processing, however the task processing of each hemisphere is slightly different. The holistic processing style of the right hemisphere is for example used to form conclusions. It is able to integrate several pieces of information simultaneously (Janiszewski, 1988); therefore it can be assumed that when evaluating a dressage performance, a judge mainly uses the right brain hemisphere to form a conclusion out of the different pieces of information from the visual system which then leads to a mark assigned to the performed task.

To filter out relevant information currently needed, competition for processing in the visual system can be biased so that required information is favored in processing. A short-term description of the needed information called attentional template is therefore used to bias competition in favor of the required information. The attentional template is a part of working memory and specifies properties of the stimuli which are currently relevant (Desimone and Duncan, 1995). Top-down biases are used to search for relevant information then (Desimone and Duncan, 1995). This means that if a distractor is competing for processing capacity with a target, visual attention and further processing focus on the target anyway due to the top-down bias. Reaction to distractors can even be suppressed to ensure proper processing of targets (Desimone and Duncan, 1995).

This is an extremely important aspect when judging in dressage sports. The judge must not be distracted by the audience or anything else happening outside the arena. He needs to focus on the critical points for each task a horse-rider combination has to perform, so that available brain capacities can be used in the most efficient way to lead to an appropriate evaluation of performance.

3.6 CATEGORIZATION AND MEMORY PROCESSES

The second step of the information processing framework, categorization, requires relation of perceived stimuli to information stored in memory (Plessner and Haar, 2006). It is therefore also closely related with the third step, memory processes. The reason for this is obvious in sports like dressage, as a movement performed by a horse-rider combination does not mean anything to a layperson, while an expert, for example a dressage judge, knows exactly how a horse is supposed to move in certain dressage tasks. To judge appropriately in sports, knowledge about the judgment criteria as well as an appropriate categorization system are indispensable (Plessner and Haar, 2006).

Differences between novices and experts can be expected concerning judgments in sports due to the fact that the process of judging highly relies on prior knowledge. Research has shown that experts are attending more relevant visual stimuli and use cognitive shortcuts based on knowledge, whereas novices took more time and also were not able to describe motion patterns as accurately as the experts (Jarodzka *et al*, 2010).

It could be proven that experts can detect form errors in a gymnastics performance better than novices do (Ste Marie and Lee, 1991) and that expert judges fixate on different parts of the body than novices do when judging a gymnastics sequence (Bard *et al*, 1980). According to Ste Marie (1999), the expert advantage could be partly caused by the fact that experts can retrieve necessary information more easily from their memory than novices can; therefore requiring less effort for processing this information and leaving more processing capacity for the actual evaluation.

It might even be possible that experienced judges use automatic processing when judging, as the required processes are stored in long-term memory and are always the same. This requires less processing capacity then (Schneider and Shiffrin, 1977). However, as automatic processing works without control of the person using it, its use is restricted by the need to evaluate information consciously. If it is used at all, it might therefore only simplify the focusing on relevant body parts in each task, but not the actual evaluation.

3.7 INFLUENCES ON JUDGEMENTS

The process of categorization can be affected by several aspects. Factors influencing judgments can for example be desire for conformity with other judges, especially when feedback is given (Damisch and Mussweiler, 2009). This might often be true in dressage, as judges get to know about the final scores for each competitor after the dressage test. They might try to avoid being the outlier giving the highest or lowest score and therefore judge more carefully. Other factors that might influence a judge are the expectation of the best competitors starting at a certain point of time, usually towards the end of a competition (Damisch and Mussweiler, 2009). The typical rank order of gymnasts in team competitions, placing the best athletes at the end, was found to lead to biased evaluation of performance by the judges due to expectancy effects (Plessner and Haar, 2006).

The reputation of an athlete also might lead to biases in judges (Plessner and Haar, 2006). Comparison processes might influence judges as well (Damisch and Mussweiler, 2009). According to Plessner and Haar (2009), judgements in sports are often based on comparisons between athletes or with prior performances of an athlete. Damisch and Mussweiler (2009) showed that if a target is perceived as similar to a standard, people also search for similarities, while they search for differences when a target is perceived as dissimilar to a standard, leading to judgments closer to the standard when searching for similarities, but farther from it when searching for dissimilarities.

In dressage sports, this could mean that – using the optimum as a standard – good performances are assigned higher marks due to use of similarity testing, while less good performances are searched for dissimilarities and thus assigned even lower marks. Comparisons might even serve as a kind of heuristic for judges (Mussweiler and Epstude, 2009), so that the process of judging can be performed faster than without using comparisons.

Memory-influenced biases related to comparison occur when prior performances of an athlete are retrieved from memory. It has been proven that judgments of gymnasts' performance where less accurate when the judges had seen the gymnasts perform in advance and performance then differed from the prior one (Ste-Marie, Lee, 1991). This effect even still lasted if the prior performance had been seen a week in advance (Ste-Marie and Valiquette, 1996). Similar effects might occur in dressage judging, as the system of judging is related to that of gymnastics.

In general, potential biases or favoritism within the judges are regularly discussed in subjectively judged sports. Often the audience or other competitors strongly disagree with an athlete’s score, or there might be one judge giving remarkably lower or higher marks than his colleagues do.

Especially nationalistic biases could be proven by research. For example, in the 2000 Olympic diving competition, the medal rankings might even have been different with unbiased judges, which was shown in a study by Emerson, Seltzer and Lin (2009). Deuel (1989) could show a tendency for nationalistic biases in judges of the dressage competitions in the 1988 Olympics, with judges tending to award higher marks to co-national riders, although the small number of judges did not allow conclusive confirmation of these biases.

Inconsistency of dressage judging scores in the United States was pointed out by Diaz *et al.* (2010). It is also often heard that people assume there are judges that give higher or lower scores than their colleagues; this could also be shown by Diaz *et al*. (2010).

3.8 INFORMATION INTEGRATION

The final step of the information processing framework, the integration of information, uses the perceived information as well as information which is retrieved from memory to integrate it into a judgment. Although a judge should ideally consider all available relevant information, the limited processing capacity of the human brain as well as other constraints, for example time pressure, leads to the use of short cuts to deal with the requirements of judging. Besides comparisons used as a kind of heuristics, it can be assumed that also several other heuristics play a role in judging dressage performances. This is caused by the very limited time and brain capacity available to assess the quality of each task performed. Instead of evaluating all the available information, a dressage judge probably has to use shortcuts to make the process of judging efficient enough.

Heuristics save time and processing capacity by not requiring all the available information and partly not even integrating the used information, which makes them faster than an optimizing process collecting and integrating all available information (Bennis and Pachur, 2006). It would even be impossible to collect virtually all relevant information due to constraints like restricted time. However, heuristics strongly depend on the environment in which they are used. They can only be used effectively in an environment to which they are adapted (Bennis and Pachur, 2006). An example for possible short cuts would be the fast-and-frugal heuristics. Such heuristics, as the Take The Best heuristic, were even shown to produce better results than optimizing models in appropriate environments (Bennis and Pachur, 2006).

In sports, decisions of experts often require quick application of knowledge from memory, for which heuristics seem to be a very useful tool. As sports environments often require fast decisions with limited information access, but decision makers are experienced and knowledgeable and thus can rely on automatized processes, fast-and-frugal heuristics are adapted well to these environments (Bennis and Pachur, 2006). It has been shown that fast and frugal decision-making can be reached with only one relevant cue. However, people search for further evidence before making their decision (Karelaia, 2006). This implies that it might be possible to define one crucial criterion and one or two relevant supportive criteria for each dressage movement. In practice, however, it has to be investigated whether this is applicable for dressage sports.

4. METHODOLOGY

4.1 PARTICIPANTS

Sixteen judges participated in this research. Participation was voluntary, and judges were able to withdraw at any time. Four judges (25%) were aged between 40 and 50, while six judges were aged between 50 and 60 respectively between 60 and 70 (37,5% each). Nine judges (56,3%) were male, seven (43,7%) were female. All judges had more than 20 years of total judging experience. However, ten judges (62,5%) had acquired the level to judge Grand Prix nationally, while four judges (25%) had 4* level and two judges (12,5%) even had acquired 5* level. 37,5% of judges already judged for more than ten years at their current level, while only 12,5% had acquired their current level less than two years ago. Fourteen judges (87,5%) had own experience in riding dressage competitions; 68,8% even competed at elite level.

4.2 MATERIALS

A Tobii T60 XL eyetracker was the most important piece of equipment. In combination with a computer, it enabled the surveillance and investigation of judges' visual attention. This eyetracking device is capable of recording the fixation of visual attention by tracking the pupil's movements after having been calibrated for each viewer. Among other things, it is able to replay a video and afterwards provide a copy of the original video including the recorded fixations of the viewer, visualized as coloured points.

To simulate the situation of judging a dressage performance, videos of a horse-rider combination performing a Grand Prix test were used. All judges saw a video of the 2009 Grand Prix test. The video of the Grand Prix test was recorded at the rider's own stable. In the set-up of the videos for the eyetracker, a questionnaire asking for basic information from the judges was included.

4.3 PROCEDURE

Judges first signed a form stating the conditions of the research, especially the possibility for judges to stop their participation at any point of time and without an explanation. The set-up for the investigation of visual attention using the eyetracker was explained to the participating judges before they were seated in front of the device. They were also asked to act as if they were actually judging a real performance, including assigning of scores and comments for each exercise being performed.

Judges were placed in a distance of about 60 centimeters from the eyetracker's screen and the eyetracker's angle was adapted in such a way that the actual eyetracking cameras at the bottom of the screen where oriented towards the judge's eyes. Then the eyetracker had to be calibrated for each judge, so that eye movements could be registered properly by the device. Afterwards, the prepared sequence with the videos of the performances and the questionnaire was started and the judges' eye movements were recorded by the eyetracker. At the same time, the scores and comments given by the judges for each exercise were written down. When the recording was finished, judges were given the opportunity to watch the video including their fixations if desired.

4.4 DATA PROCESSING

The videos with the recorded fixations of each judge were evaluated using a checklist to count the fixations per body part of horse and rider. The checklist was subdivided into different parts of the forehand, hindquarters and rider. Included points were head, mouth, poll, neck, shoulder, forearm, knee, lower foreleg and breast for the forehand. The hindquarters were subdivided into croup, tail, thigh, flank, lower leg, hock, and lower hindleg (cannon bone and below). Finally, the points included for the rider were head, torso, hand, thigh, knee and lower leg. Fixations on each of these body parts were counted while replaying the video in slow motion. A total number of fixations for forehand, hindquarters and rider was calculated as well.

Exercises included in the analysis for this research were all those exercises contained in a Grand Prix test which are ridden in walk or canter. For walk, these were extended and collected walk. For canter, exercises were grouped into categories which were collected canter (containing enter in collected canter, proceed in collected canter and collected canter with flying change of leg), extended canter, half-passes in canter, flying changes of leg (containing flying changes of leg every second stride, flying changes of leg every stride and flying change of leg between the pirouettes) and pirouettes (containing pirouette to the left and to the right).

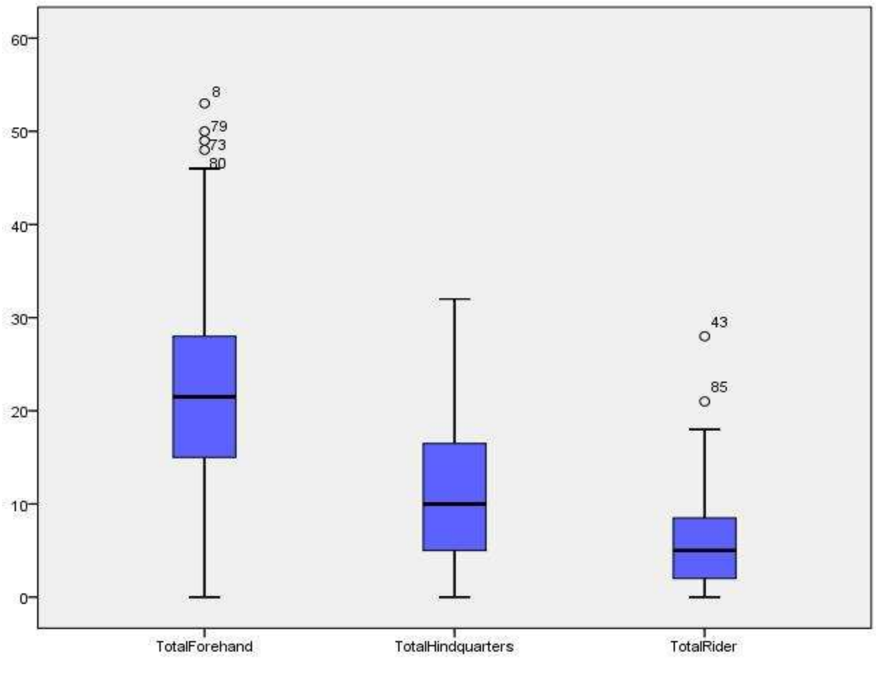
Besides frequency tables and descriptive statistics, repeated measures ANOVA were used to analyze differences in the number of fixations on forehand, hindquarters and rider. The repeated measures design was necessary because of the fact that the same judges evaluated the different exercises, therefore being counted several times. To analyze differences of fixation numbers between experience levels of judges, as well as for the analysis of the effect of experience on the total score and the score for canter exercises, univariate ANOVA tests were used.

5. RESULTS

5.1 GENERAL DIFFERENCES IN FIXATION NUMBERS

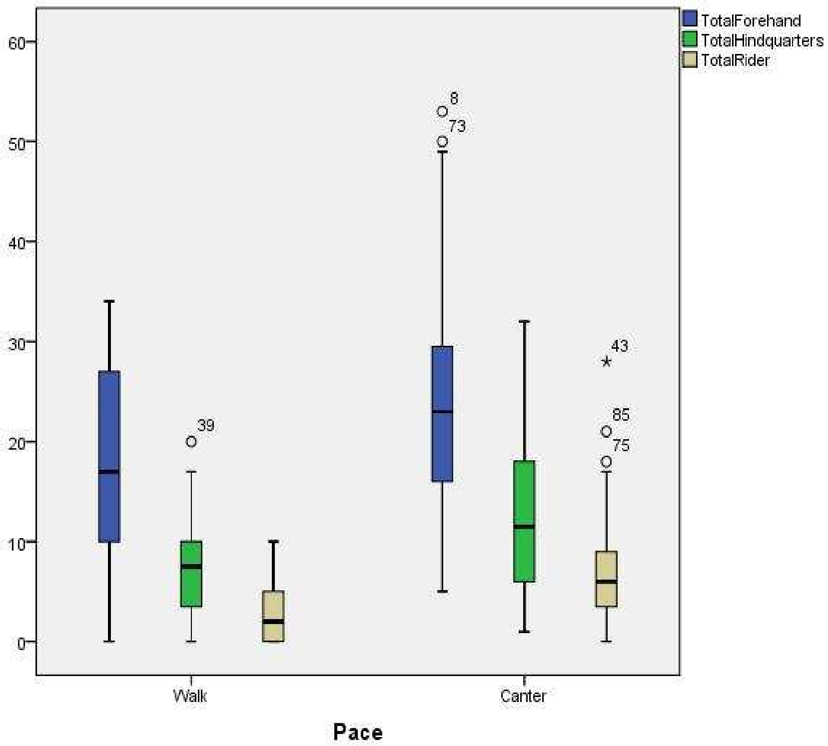
Total numbers of fixations on the forehand ranged from 0 to 53 (mean 22.29, SD 10.949). Fixations on the hindquarters ranged from 0 to 32 (mean 11.14, SD 7.303), and fixations on the rider ranged from 0 to 28 (mean 5.72, SD 5.046).

The differences in the number of fixations of each judge on the forehand and hindquarters as well as on the rider were analyzed using a repeated measures ANOVA with a Huynh-Feldt correction factor due to violated assumption of sphericity. Overall differences in number of fixations were found ($F(1.668, 91.74)=151.858$ with $p<=0.001$). Judges focused significantly more on the forehand than on the hindquarters ($p<=0.001$) or the rider ($p<=0.001$), and they also focused significantly more on the hindquarters than on the rider ($p<=0.001$).



Picture 1:
Total fixations on forehand, hindquarters and rider

In walk, judges' overall fixations on the forehand had a mean of 17.72 (SD 9.358), fixations on the hindquarters had a mean of 7.5 (SD 5.187), and fixations on the rider had a mean of 2.78 (SD 2.768). In canter, judges' overall fixations on the forehand had a mean of 24.13 (SD 11.055), fixations on the hindquarters had a mean of 12.6 (SD 7.54), and fixations on the rider had a mean of 6.9 (SD 5.279).



Picture 2:
Fixations on forehand, hindquarters and the rider in walk and canter

Again, a repeated measures ANOVA with a Huynh-Feldt correction factor due to violated assumption of sphericity was used to analyze differences between walk and canter in the number of fixations on the forehand, hindquarters and rider. The test showed significant differences between walk and canter (F (2, 109)=24.06, p<=0,001).

5.2 CANTER

Overall, fixations on the forehand in canter ranged from 5 to 53 (mean 24.13, SD 11.055). Fixations on the hindquarters varied from 1 to 32 (mean 12.6, SD 7.54). Fixations on the rider varied between 0 and 28 (mean 6.9, SD 5.279). The total number of fixations in canter ranged from 14 to 80 (mean 43.63, SD 16,863).

A repeated measures ANOVA was used to analyze differences. As sphericity could not be assumed ($p<0{,}05$), the Huynh-Feldt correction factor was used to adapt the degrees of freedom. It was shown that in canter, judges focused on forehand, hindquarters and the rider with significantly different frequencies ($F(1.749, 68.25)=109.869$ with $p<=0.001$).

They focused on the forehand significantly more often than on the hindquarters ($p<=0.001$) or the rider ($p<=0.001$). They also focused significantly more on the hindquarters than on the rider ($p<=0.001$).

Collected Canter

In collected canter, number of frequencies of fixations on the forehand ranged from 18 to 35, with a mean of 25.88 and a SD of 4.924.

Fixations on the hindquarters ranged from 5 to 31, with a mean of 17.81 and a SD of 6.39. Fixations on the rider ranged from 0 to 28, with a mean of 11.19 and a SD of 6.863.

Using a repeated measures ANOVA, it turned out that there were significant differences between the frequencies judges focused on forehand, hindquarters or rider ($F(2, 14)=27.744$, $p<=0.001$). Judges focused significantly more on the forehand than on the hindquarters ($p=0{,}001$) or the rider($p<=0.001$). They also focused on the hindquarters significantly more than on the rider($p=0{,}005$).

Extended Canter

In extended canter, frequency of forehand fixations varied between 5 and 17 (mean 11.5, standard deviation 3.933). Fixations on the hindquarters varied between 1 and 11 (mean 5.44, SD 2.555). Fixations on the rider ranged from 0 to 10 (mean 5.13, SD 3.074).

A repeated measures ANOVA showed significant differences in fixation frequencies of forehand, hindquarter and rider ($F(2, 14)=18.089$, $p<=0.001$). Judges focused significantly more on the forehand than the hindquarters (p<=0.001) or the rider (p<=0.001). However, no significant differences between fixations on the hindquarters and the rider existed (p=0,794).

Half-Passes

In the half-pass in canter, fixations on the forehand ranged from 14 to 28 (mean 22.0, SD 4.017). Fixations on the hindquarters were between 3 and 15 (mean 7.13, SD 3.202), while fixations on the rider varied between 0 and 12 (mean 6.12, SD 3.81).

A repeated measures ANOVA revealed significant differences between frequency of fixation on the different body parts (F (2,14)=85,488, p<=0.001). Once again, frequency of fixations on the forehand was significantly higher than on the hindquarters (p<=0.001) or rider (p<=0.001), but differences between hindquarters and rider did not reach significance (p=0,423).

Flying changes of leg

In the flying changes of leg, judges' fixations on the forehand varied between 28 and 53 (mean 41.06, SD 7.169). Fixations on the hindquarters ranged from 3 to 29 (mean 14.81, SD 7.101) and fixations on the rider varied between 0 and 18 (mean 6.19, SD 5.218).

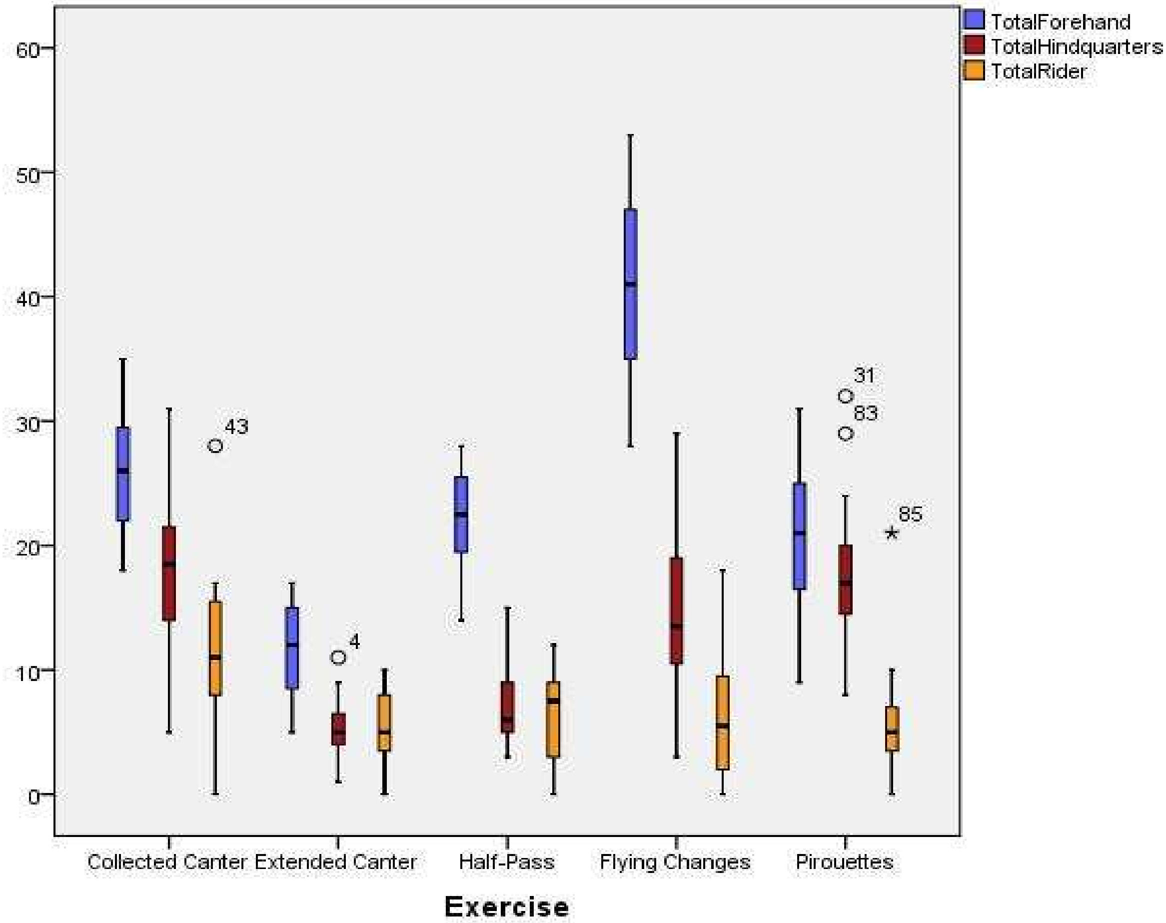
Again, a repeated measures ANOVA showed significant differences in frequency of fixation of forehand, hindquarters and rider (F (2, 14)=122.252, p<=0.001). Also in the flying changes, judges focused significantly more on the forehand than on the hindquarters (p<=0.001) or the rider (p<=0.001). They also focused significantly more on the hindquarters than on the rider (p=0,002).

Canter pirouettes

In pirouettes, frequency of forehand fixations varied between 9 and 31 (mean 20.19, SD 5.98). Fixations on the hindquarters ranged from 8 to 32 (mean 17.81, SD 6.442), and fixations on the rider varied between 0 and 21 (mean 5.88, SD 4.815).

The repeated measures ANOVA once again showed significant differences between fixation frequencies of forehand, hindquarters and rider ($F(2, 14)=26.996$, $p<=0.001$)

In the pirouettes, no significant difference in judges' fixations on the forehand and the hindquarters was found ($p=0.242$). Differences between fixations on the forehand and the rider respectively the hindquarters and the rider were significant, however ($p<=0.001$ for both).



Picture 3: Differences in fixations on forehand, hindquarters and rider in the different exercises ridden in canter

5.3 WALK

Overall fixations in walk ranged from 0 to 34 for the forehand (mean 17.72, SD 9.358). Fixations on the hindquarters ranged from 0 to 20 (mean 7.5, SD 5.187). Fixations on the rider varied between 0 and 10 (mean 2.78, SD 2.768). The total number of fixations in walk varied between 0 and 40 fixations (mean 28, SD 9.916).

A repeated measures ANOVA, using the Greenhouse-Geisser correction factor due to violated assumption of sphericity, showed significant differences between number of fixations on the forehand, the hindquarters and the rider ($F(1.229, 18.45)=41.76$, $p<=0.001$)

Judges focused significantly more on the forehand than on the hindquarters ($p<=0.001$) or the rider ($p<=0.001$). Also fixations on the hindquarters were significantly higher than on the rider ($p<=0.001$).

Extended Walk

In extended walk, fixations on the forehand ranged from 0 to 34 (mean 23.81, SD 8.643). Fixations on the hindquarters varied between 0 and 10 (mean 4.25, SD 2.978) and fixations on the rider between 0 and 6 (mean 1.88, SD 2.247).

A repeated measures ANOVA, again using the Greenhouse-Geisser correction factor as sphericity could not be assumed, showed significant differences between number of fixations on the different body areas ($F(1.244, 8.708)=84.2$, $p<=0.001$). Fixations on the forehand were significantly higher than those on the hindquarters ($p<=0.001$) or the rider ($p<=0.001$). Fixations on the hindquarters also were significantly higher than those on the rider ($p=0{,}018$).

Collected Walk

In collected walk, forehand fixations varied between 0 and 20 (mean 11.63, SD 5.201). Fixations on the hindquarters were between 0 and 20 (mean 10.75, SD 4.919), while those on the rider ranged from 0 to 10 (mean 3,69, SD 3.005).

Using a repeated measures ANOVA, it turned out that there were significant differences in frequencies of fixations between forehand, hindquarters and rider ($F(2, 14)=21.085$,

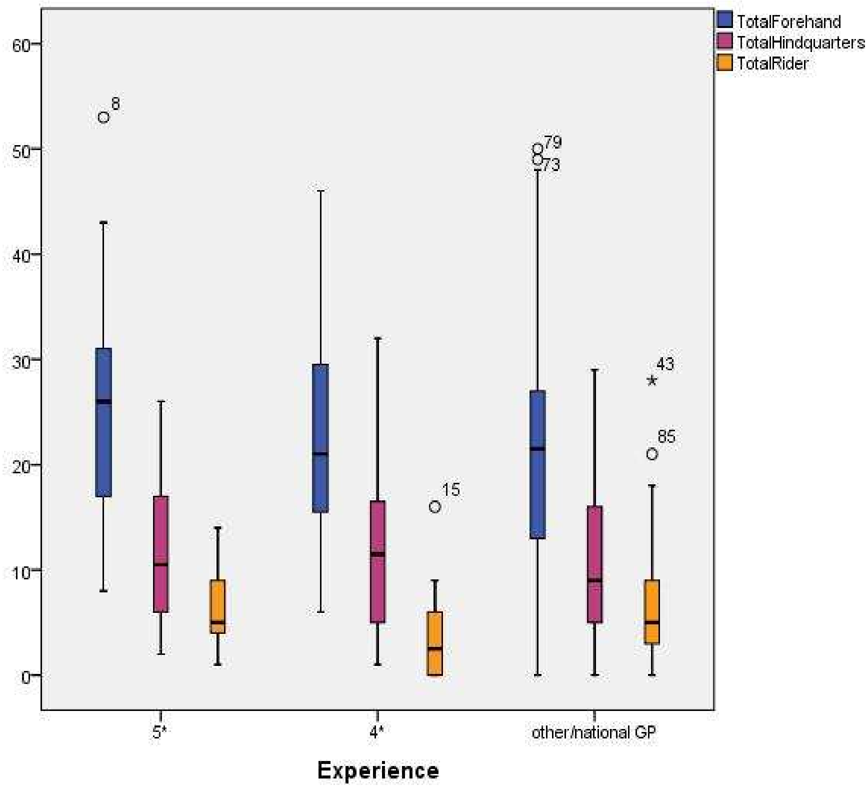
$p <= 0.001$). No significant difference in the number of judges' fixations on the forehand or the hindquarters were found ($p=0.566$). However, differences in number of fixations on the forehand and the rider ($p <= 0.001$) as well as differences between the hindquarters and the rider ($p <= 0.001$) were significant.

5.4 INFLUENCE OF EXPERIENCE

Total fixations ranged from 22 to 80 for 5* judges (mean 43.43, SD 19.334). 4* judges had between 14 and 68 fixations (mean 37.71, SD 14.303), while judges of national level ranged from 0 to 76 fixations (mean 17.91, SD 17.91). An ANOVA was used to test for differences in total number of fixations between judges of different experience level. This test did not reveal any significant differences between judges of the different levels ($F(2, 109)=0.565$, $p=0.57$).

It was then tested whether experience accounted for differences between number of total fixations on the forehand, the hindquarters and the rider. For judges of 5* level, the number of fixations on the forehand ranged from 8 to 53 (mean 25.79, SD 12.336), for 4* level judges it was between 6 and 46 (mean 22.07, SD 10.281), and for national level judges it varied between 0 and 50 (mean 21.69, SD 10.953). Fixations on the hindquarters were between 2 and 26 for 5* judges (mean 11.57, SD 6.991), between 1 and 32 for 4* judges (mean 12.07, SD 7.874) and between 0 and 29 for national level judges (mean 10.69, SD 7.192). Fixations on the rider of 5* judges were between 1 and 14 (mean 6.07, SD 3.668), those of 4* judges varied between 0 and 16 (mean 3.57, SD 3.91) and for national level judges it varied between 0 and 28 (mean 6.51, SD 5.469).

Using a repeated measures ANOVA with a Huynh-Feldt correction factor due to violated assumption of sphericity, general differences between total fixations on forehand, hindquarters and rider turned out to be significant ($F(1.675, 90.504)= 116.214$, $p<=0.001$). However, the between-subjects effect for variation between judges of different experience levels in difference between fixations was not significant ($F(2, 108)= 0.565$, $p=0,57$).



Picture 4:
Fixations on forehand, hindquarters and rider for different experience levels

It was tested whether there were differences between experience levels when testing walk and canter separately using a repeated measures ANOVA as well, however it turned out that there were no significant differences (walk ($F(2, 28)=0.06$, $p=0.994$), canter ($F(2, 76)=0.73$, $p=0.485$)).

The variation in number of fixations between experience levels was tested for each exercise separately, again using repeated measure ANOVA.

Collected Canter

In collected canter, the mean number of fixations on the forehand for 5* judges was 32 (SD 4.243), for 4* judges it was 25.25 (SD 4.924), and for national level judges it was 24.9 (SD 4.557). Mean number of fixations on the hindquarters for 5* judges was 19 (SD 2.828), for 4* judges it was 20.5 (SD 7.326), and for national level judges it was 16.5 (SD 6.621). Mean number of fixations on the rider for 5* judges was 10 (SD 1.414), for 4* judges it was 8 (SD 6.583), and for national level judges it was 12.7 (SD 7.514).

The test of between-subjects effects did not reveal any significant differences in fixation numbers between experience levels ($F(2, 12)=0.26$, $p=0.775$).

Extended Canter

In extended canter, the mean number of fixations on the forehand for 5* judges was 16 (SD 1.414), for 4* judges it was 12.75 (SD 4.573), and for national level judges it was 10.1 (SD 3.348). Mean number of fixations on the hindquarters for 5* judges was 7.5 (SD 4.95), for 4* judges it was 5.25 (SD 2.63), and for national level judges it was 5.1 (SD 2.183). Mean number of fixations on the rider for 5* judges was 3.5 (SD 3.536), for 4* judges it was 3.5 as well (SD 2.38), and for national level judges it was 6.1 (SD 3.107).

The test of between-subjects effects did not reveal any significant differences in fixation numbers between experience levels ($F(2, 12)=1.096$, $p=0.363$).

Half-passes

In the half-passes in canter, the mean number of fixations on the forehand for 5* judges was 23 (SD 5.657), for 4* judges it was 21.25 (SD 2.754), and for national level judges it was 22.1 (SD 4.508). Mean number of fixations on the hindquarters for 5* judges was 8 (SD 2.828), for 4* judges it was 10 (SD 4.397), and for national level judges it was 5.8 (SD 1.989). Mean number of fixations on the rider for 5* judges was 5 (SD 5.657), for 4* judges it was 4.25 (SD 3.5), and for national level judges it was 7.1 (SD 3.695).

The test of between-subjects effects did once again not reveal any significant differences in fixation numbers between experience levels ($F(2, 12)=0.026$, $p=0.975$).

Flying Changes of Leg

In the flying changes, the mean number of fixations on the forehand for 5* judges was 48 (SD 7.071), for 4* judges it was 39.75 (SD 6.131), and for national level judges it was 40.2 (SD 7.436). Mean number of fixations on the hindquarters for 5* judges was 19.5 (SD 9.192), for 4* judges it was 11.5 (SD 6.608), and for national level judges it was 15.2 (SD 7.084). Mean number of fixations on the rider for 5* judges was 9 (SD 7.071), for 4* judges it was 2 (SD 2.708), and for national level judges it was 7.3 (SD 5.143).

For the flying changes of leg, the test of between-subjects effects actually did reveal significant differences in the number of fixations on the forehand, the hindquarters and the rider between experience levels (F (2, 12)=3.998, p=0.044).

Pirouettes

In canter pirouettes, the mean number of fixations on the forehand for 5* judges was 28 (SD 4.243), for 4* judges it was 20.25 (SD 2.062), and for national level judges it was 18.6 (SD 6.31). Mean number of fixations on the hindquarters for 5* judges was 13.5 (SD 7.778), for 4* judges it was 18.75 (SD 8.921), and for national level judges it was 18.3 (SD 5.579). Mean number of fixations on the rider for 5* judges was 5 (SD 2.828), for 4* judges it was 5.25 (SD 3.594), and for national level judges it was 6.3 (SD 5.736).

The test of between-subjects effects did again not reveal any significant differences in fixation numbers between experience levels (F (2, 12)=0.09, p=0.914).

Extended Walk

In extended walk, the mean number of fixations on the forehand for 5* judges was 23.5 (SD 7.778), for 4* judges it was 25.25 (SD 9.032), and for national level judges it was 23.3 (SD 9.452). Mean number of fixations on the hindquarters for 5* judges was 3.5 (SD 2.121), for 4* judges it was 4.25 (SD 4.272), and for national level judges it was 4.4 (SD 2.836). Mean number of fixations on the rider for 5* judges was 5 (SD 0.0), for 4* judges it was 0.5 (SD 1.0), and for national level judges it was 1.8 (SD 2.251).

In extended walk, the test of between-subjects effects again did not reveal any significant differences in fixation numbers between experience levels (F (2, 12)=0.045, p=0.956).

Collected Walk

In collected walk, the mean number of fixations on the forehand for 5* judges was 10 (SD 2.828), for 4* judges it was also 10 (SD 4.0), and for national level judges it was 12.6 (SD 6.004). Mean number of fixations on the hindquarters for 5* judges was 10 (SD 2.828), for

4* judges it was 14.25 (SD 5.123), and for national level judges it was 9.5 (SD 4.836). Mean number of fixations on the rider for 5* judges was 5 (SD 0.0), for 4* judges it was 1.5 (SD 1.732), and for national level judges it was 4.3 (SD 3.335).

Also for collected walk, the test of between-subjects effects did not reveal any significant differences in fixation numbers between experience levels ($F_{(2, 12)}=0.017$, $p=0.983$).

5.5 SCORES

Overall scores given for the performance by the judges ranged from 60.0% to 69.15% (mean 64.821%, SD 2.506). Scores for canter exercises ranged from 82 to 99 points (mean 88.125, SD 4.205).

Using an ANOVA, it was tested whether experience level of judges accounted for differences in the total scores. However, these differences did not turn out to be significant ($F_{(2, 13)}=1.239$, $p=0.322$). Also scores for canter exercises were tested for significant differences using an ANOVA. Here, significant differences between different experience levels of judges were detected ($F_{(2, 13)}=8.085$, $p=0.005$). Pairwise comparisons showed that differences in scores between judges of 5* level and 4* level were significant ($p=0.017$), as were differences between 4* and national level ($p=0.002$), whereas differences between 5* and national level were not significant ($p=0.95$).

A repeated measures ANOVA was used to find out whether the score for canter exercises changed with different numbers of fixations on the body parts. However, the between-subjects effect for the canter score and the fixations did not turn out to be significant ($F_{(11, 4)}=0.841$, $p=0.631$).

6. Discussion

6.1 DISCUSSION OF RESULTS

This research aimed at comparing patterns of visual attention focus in dressage judges evaluating one horse-rider combination performing a Grand Prix test. It was investigated whether there are significant differences in visual attention focus between different body parts of a performing horse-rider combination, but also whether there are differences in visual attention between judges of different levels. Correlations between the fixations of visual attentions and the given scores were investigated as well.

Concerning the differences in visual attention focus on the different body parts, patterns of visual attention could be found which differed only slightly between gaits or exercises.In general, judges had a higher number of fixations on the forehand of the horse than on the hindquarters, but the number of fixations on the hindquarters was still higher than the number of fixations on the rider.

The total number of fixations was lower for walk than for canter, however the pattern of a higher number of fixations on the forehand than on the hindquarters as well as an even lower number of fixations on the rider hold true for both walk and canter, even although there were some outliers with a higher number of fixations.

Differences from this pattern were only found for few exercises. These were the extended canter and the half-passes in canter, were there was no significant difference in the number of fixations on the hindquarters and the rider. In the canter pirouettes as well as in collected walk, no significant difference between the number of fixations on the forehand and hindquarters was found. In collected walk, however, this might be due to disadvantageous camera position, filming the horse almost only from behind. Therefore this result might be different with a different camera position, as well as in real judging where the judge's position on the short side of the arena is slightly different from the camera position in this video.

When evaluating differences in numbers of fixations on the body parts between the different levels of judges, no significant differences between judges of national, 4* and 5* level were found. Even when looking at the different exercises separately, only in the flying changes differences turned out to be significant; however as it was the 4* level which differed significantly from the 5* and national level, this is probably not an effect of the experience level itself, but rather of the individual judges.

This is also in line with the finding that the scores for canter exercises were significantly different for judges of 4* level, whereas no significant differences were found between judges of 5* and national level. This again leads to the assumption that the differences are rather due to the individual judges, not their experience level. Overall, differences in scores between the different experience levels also were not significant.

The fact that basically all judges focused most on the forehand in all exercises besides the canter pirouettes leads to the assumption that the forehand must give cues which allow judges to evaluate the performance of a horse-rider combination. Considering that research has shown that it is necessary for judges to focus their attention appropriately so that they actually perceive the information required for further processing (Plessner and Haar, 2006), it can be assumed that, as all judges focus mainly on the forehand, the forehand provides the most relevant information for dressage judges.

Although judges participating in this research had different experience levels, none of them could be considered a novice judge, as all of them had more than 20 years of judging experience and were allowed to judge Grand Prix. Considering that Ste-Marie (1999) showed that expert judges in gymnastics fixate on different body parts than novice judges, and that Jarodzka *et al.* (2010) pointed out that expert judges attend more relevant visual stimuli than novice judges, this leads to the assumption that the pattern of visual attention on the body parts found in this research might be generalizable. As all judges participating in this research have acquired a high level and use basically the same pattern of visual attention, focusing more on the forehand than on the hindquarters and even less on the rider in almost all exercises, it can be assumed that this pattern is most useful for fast and effective evaluation of dressage performance.

The attentional template, which is basically a description of the visual information required at a certain moment, combined with top-down biases from the brain to the visual perception mechanisms, helps in focusing on relevant visual information (Desimone and Duncan, 1995). In combination with the use of expert knowledge developed with experience, judges develop search strategies which allow them to focus on the most relevant available information (Plessner and Haar, 2006; Bard *et al.,* 1980) and thus evaluate a performance properly. Due to constraints as for example time pressure, judges probably use heuristics to allow for faster decision-making (Plessner and Haar, 2006, Jarodzka *et al.,* 2010). This also heavily relies on prior experience, as heuristics can only function properly in an appropriate environment (Bennis and Pachur, 2006). The fast-and-frugal heuristic has been shown to work well under time constraints and limited information, as it is often the case in sports-related decision-making (Bennis and Pachur, 2006). Karelaia (2006) has even shown that, if previous knowledge about the most relevant cues exists, only one cue can be sufficient to make a successful decision. However, people still seek for more information to confirm their decision, which is a successful strategy for decision-making. As Witte *et al.* (2009) have shown that only a few parameters are necessary to describe movement variances in horses, this brings up the question of whether it would be possible to define one or two crucial elements, combined with some additional important cues, for dressage exercises. Up to now, there are lots of different criteria for each exercise, which are probably unfeasible for actual decision-making in dressage judging given the time constraints and the limited processing capacity of the human brain which rather call for use of heuristics (Plessner and Haar, 2006). By defining only few crucial criteria, judges would be provided with clearer definitions of the most relevant aspects on which they have to focus their attention. Especially novice judges might then be able to develop appropriate shortcuts and learn from the expert judges' patterns of visual attention. This would enable the novice judges to develop the experts' pattern of visual attention, which is different from that of novices (Bard *et al*., 1980) and thus might lead to more consistency in judging.

As the results of this research have shown a relatively consistent pattern of visual attention for all judges, with the highest amount of fixations on the forehand, and as all participating judges can be considered experts, it can be deducted that the most relevant cues can be found in the forehand region. Focusing on such an information-rich region probably allows the judges to evaluate the overall performance quality without having to process and evaluate all the available information, which would be impossible due to time and capacity constraints.

The only exception from the pattern of mainly forehand fixations was in the canter pirouettes, where no significant differences between the forehand and hindquarter were found. This might be because in this case the cues for relevant aspects, as the diameter of the pirouette and the lowering and bending of the horse's haunches (FN, 2005, KNHS, 2006), are found in the hindquarters. Therefore the proposition of judges focusing mainly on body regions that allow them to conclude the overall score still holds true, although the pattern in this case was different.

In other exercises, however, there are also important aspects for the evaluation which are related to the hindquarters, for example forward impulse from the hindlegs in collected walk or extended canter (KNHS, 2006). However, there are also many aspects concerning the forehand, as for example the frame extension in the neck in extended canter or the bend of the horse in the half-passes (KNHS, 2006). Considering the constant pattern of visual attention with most fixations on the forehand, judges obviously conclude on the quality of performance mainly by looking at the forehand.

6.2 LIMITATIONS OF THE STUDY DESIGN

This research suffered from several limitations to the study design. One was the number of participants, as only sixteen judges participated. The quality of the film that these judges watched also must be seen as a limitation, because the image quality itself was not very good and the camera position was not exactly the same as in real judging, thereby leading to slightly different angles when looking at the horse-rider combination. Probably judges at different positions around the arena use different patterns of visual attention; especially differences between judges placed at the short and long sides of the arena might be found.

The set-up of this research did not allow the judges to distract themselves from the horse-rider combination, as distracting factors, for example the audience, which generally exist in a real judging situation, were not included in the film. Therefore the pattern of visual attention might be more consistent than in real judging, were judges might be distracted form the horse-rider combination. Another limitation of this research is that the film showed only one horse-rider combination. Therefore it might be that the relatively consistent pattern of visual attention which was found is only valid for this specific horse-rider combination, but not for others.

These limitations make it difficult to generalize from the results of this research.

7. Conclusion and Recommendations

This research has identified a relatively consistent pattern of visual attention within the participating judges, with the majority of fixations of visual attention being directed at the forehand, significantly less on the hindquarters and even less on the rider. Previous research has shown that decision-making in sports, for example due to time constraints, must rely on heuristics and that these heuristics need the right information to function properly for decision-making (Plessner and Haar, 2006; Jarodzka *et al*., 2010; Bennis and Pachur, 2006). Other researchers have shown that in gymnastics, with its fairly comparable judging system, expert judges fixate differently than novice judges do (Ste-Marie, 1999, Bard *et al*., 1980). Therefore it can be concluded that in dressage expert judges probably also use a pattern of visual attention, which might be different from that of novice judges. The judges which participated in this research can all considered to be experts due to their long experience and high judging level. The assumption that they might show a similar pattern of visual attention was confirmed, and overall, no significant differences between the slightly different experience levels of the judges were found.

This research, however, offers only limited opportunities for generalization due to the small number of participating judges. Further research should therefore be done to investigate whether the pattern of visual attention still remains relatively constant with a larger number of participating judges of expert level. Also differences to novice judges, which have only acquired remarkably lower levels, should be investigated to find potential differences in their patterns of visual attention compared to those of the expert judges.

If such differences exist, the visual attention pattern of the expert judges might be used to help novice judges to develop such a pattern themselves. It also might be used to deviate criteria from it which are most relevant when judging a dressage performance, thus also helping the novice judges to concentrate on the most important body parts of a horse-rider combination whose performance they have to evaluate. Such criteria might then even be included in the Judge's Handbook which defines the relevant criteria for performance evaluation. Thereby, especially judges with less experience might be able to develop more efficient patterns of visual attention and use heuristics successfully by focusing on the most relevant information. The patterns of visual attention used by the expert judges might thereby help to improve the training of novice judges by enabling them to learn from the experts' experience.

However, to be able to generalize from this research, there have been to many limitations and constraints. Therefore, further research should be done to investigate whether the pattern of visual attention which was found in this research still holds true with a higher number of participating judges and different videos, especially from different positions at the arena and showing several different horse-rider combinations. This will then allow for generalization of the results.

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9. Annex

9.1 SPSS OUTPUT

9.1.1. DESCRIPTIVE STATISTICS

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
TotalForehand	112	0	53	22,29	10,949
TotalHindquarters	112	0	32	11,14	7,303
TotalRider	112	0	28	5,72	5,046
Valid N (listwise)	112				

Pace = Walk

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
TotalForehand	32	0	34	17,72	9,358
TotalHindquarters	32	0	20	7,50	5,187
TotalRider	32	0	10	2,78	2,768
Valid N (listwise)	32				

a. Pace = Walk

Pace = Canter

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
TotalForehand	80	5	53	24,13	11,055
TotalHindquarters	80	1	32	12,60	7,540
TotalRider	80	0	28	6,90	5,279
Valid N (listwise)	80				

a. Pace = Canter

Experience = 5*

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
TotalFixations	14	22	80	43,43	19,334
Valid N (listwise)	14				

a. Experience = 5*

Experience = 4*

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
TotalFixations	28	14	68	37,71	14,303
Valid N (listwise)	28				

a. Experience = 4*

Experience = other/national GP

Descriptive Statistics[a]

	N	Minimum	Maximum	Mean	Std. Deviation
TotalFixations	70	0	76	38,89	17,191
Valid N (listwise)	70				

a. Experience = other/national GP

9.1.2. REPEATED MEASURES ANOVA FOR FOREHAND, HINDQUARTERS, RIDER

General Linear Model

Within-Subjects Factors

Measure:MEASURE_1

Focus	Dependent Variable
1	TotalForehand
2	TotalHindquarters
3	TotalRider

Descriptive Statistics

	Mean	Std. Deviation	N
TotalForehand	22,29	10,949	112
TotalHindquarters	11,14	7,303	112
TotalRider	5,72	5,046	112

Multivariate Tests[b]

Effect		Value	F	Hypothesis df	Error df	Sig.
Focus	Pillai's Trace	,681	117,310[a]	2,000	110,000	,000
	Wilks' Lambda	,319	117,310[a]	2,000	110,000	,000
	Hotelling's Trace	2,133	117,310[a]	2,000	110,000	,000
	Roy's Largest Root	2,133	117,310[a]	2,000	110,000	,000

a. Exact statistic

b. Design: Intercept

Within Subjects Design: Focus

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
Focus	,785	26,612	2	,000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Epsilon[a]		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Focus	,823	,834	,500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept

Within Subjects Design: Focus

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
Focus	Sphericity Assumed	15991,625	2	7995,813
	Greenhouse-Geisser	15991,625	1,646	9714,006
	Huynh-Feldt	15991,625	1,668	9588,500
	Lower-bound	15991,625	1,000	15991,625
Error(Focus)	Sphericity Assumed	11689,042	222	52,653
	Greenhouse-Geisser	11689,042	182,733	63,968
	Huynh-Feldt	11689,042	185,125	63,141
	Lower-bound	11689,042	111,000	105,307

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
Focus	Sphericity Assumed	151,858	,000
	Greenhouse-Geisser	151,858	,000
	Huynh-Feldt	151,858	,000
	Lower-bound	151,858	,000

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	Focus	Type III Sum of Squares	df	Mean Square	F	Sig.
Focus	Linear	15378,286	1	15378,286	231,654	,000
	Quadratic	613,339	1	613,339	15,758	,000
Error(Focus)	Linear	7368,714	111	66,385		
	Quadratic	4320,327	111	38,922		

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	57252,964	1	57252,964	613,166	,000
Error	10364,369	111	93,373		

Estimated Marginal Means

Focus

Estimates

Measure:MEASURE_1

Focus	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	22,295	1,035	20,245	24,345
2	11,143	,690	9,775	12,510
3	5,723	,477	4,778	6,668

Pairwise Comparisons

Measure:MEASURE_1

(I) Focus	(J) Focus	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	11,152*	1,063	,000	9,046	13,258
	3	16,571*	1,089	,000	14,414	18,729
2	1	-11,152*	1,063	,000	-13,258	-9,046
	3	5,420*	,711	,000	4,011	6,829
3	1	-16,571*	1,089	,000	-18,729	-14,414
	2	-5,420*	,711	,000	-6,829	-4,011

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	,681	117,310[a]	2,000	110,000	,000
Wilks' lambda	,319	117,310[a]	2,000	110,000	,000
Hotelling's trace	2,133	117,310[a]	2,000	110,000	,000
Roy's largest root	2,133	117,310[a]	2,000	110,000	,000

Each F tests the multivariate effect of Focus. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

9.1.3 REPEATED MEASURES ANOVA FOR FOREHAND, HINDQUARTERS, RIDER BY EXPERIENCE

General Linear Model

Within-Subjects Factors

Measure:MEASURE_1

Focus	Dependent Variable
1	TotalForehand
2	TotalHindquarters
3	TotalRider

Between-Subjects Factors

		Value Label	N
Experience	1	5*	14
	2	4*	28
	4	other/national GP	70

Descriptive Statistics

	Experience	Mean	Std. Deviation	N
TotalForehand	5*	25,79	12,336	14
	4*	22,07	10,281	28
	other/national GP	21,69	10,953	70
	Total	22,29	10,949	112
TotalHindquarters	5*	11,57	6,991	14
	4*	12,07	7,874	28
	other/national GP	10,69	7,192	70
	Total	11,14	7,303	112
TotalRider	5*	6,07	3,668	14
	4*	3,57	3,910	28
	other/national GP	6,51	5,469	70
	Total	5,72	5,046	112

Multivariate Tests[c]

Effect		Value	F	Hypothesis df
Focus	Pillai's Trace	,629	91,653[a]	2,000
	Wilks' Lambda	,371	91,653[a]	2,000
	Hotelling's Trace	1,697	91,653[a]	2,000
	Roy's Largest Root	1,697	91,653[a]	2,000
Focus * Experience	Pillai's Trace	,073	2,064	4,000
	Wilks' Lambda	,928	2,064[a]	4,000
	Hotelling's Trace	,077	2,063	4,000
	Roy's Largest Root	,065	3,569[b]	2,000

Multivariate Tests[c]

Effect		Error df	Sig.
Focus	Pillai's Trace	108,000	,000
	Wilks' Lambda	108,000	,000
	Hotelling's Trace	108,000	,000
	Roy's Largest Root	108,000	,000
Focus * Experience	Pillai's Trace	218,000	,087
	Wilks' Lambda	216,000	,087
	Hotelling's Trace	214,000	,087
	Roy's Largest Root	109,000	,032

a. Exact statistic

b. The statistic is an upper bound on F that yields a lower bound on the significance level.

c. Design: Intercept + Experience

Within Subjects Design: Focus

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Mauchly's W	Approx. Chi-Square	df	Sig.
Focus	,768	28,458	2	,000

Mauchly's Test of Sphericity[b]

Measure:MEASURE_1

Within Subjects Effect	Epsilon[a]		
	Greenhouse-Geisser	Huynh-Feldt	Lower-bound
Focus	,812	,838	,500

Tests the null hypothesis that the error covariance matrix of the orthonormalized transformed dependent variables is proportional to an identity matrix.

a. May be used to adjust the degrees of freedom for the averaged tests of significance. Corrected tests are displayed in the Tests of Within-Subjects Effects table.

b. Design: Intercept + Experience

Within Subjects Design: Focus

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		Type III Sum of Squares	df	Mean Square
Focus	Sphericity Assumed	12134,105	2	6067,053
	Greenhouse-Geisser	12134,105	1,624	7472,447
	Huynh-Feldt	12134,105	1,675	7243,609
	Lower-bound	12134,105	1,000	12134,105
Focus * Experience	Sphericity Assumed	308,175	4	77,044
	Greenhouse-Geisser	308,175	3,248	94,890
	Huynh-Feldt	308,175	3,350	91,984
	Lower-bound	308,175	2,000	154,088
Error(Focus)	Sphericity Assumed	11380,867	218	52,206
	Greenhouse-Geisser	11380,867	176,999	64,299
	Huynh-Feldt	11380,867	182,591	62,330
	Lower-bound	11380,867	109,000	104,412

Tests of Within-Subjects Effects

Measure:MEASURE_1

Source		F	Sig.
Focus	Sphericity Assumed	116,214	,000
	Greenhouse-Geisser	116,214	,000
	Huynh-Feldt	116,214	,000
	Lower-bound	116,214	,000
Focus * Experience	Sphericity Assumed	1,476	,211
	Greenhouse-Geisser	1,476	,220
	Huynh-Feldt	1,476	,219
	Lower-bound	1,476	,233

Tests of Within-Subjects Contrasts

Measure:MEASURE_1

Source	Focus	Type III Sum of Squares	df	Mean Square	F	Sig.
Focus	Linear	11735,436	1	11735,436	178,184	,000
	Quadratic	398,669	1	398,669	10,342	,002
Focus * Experience	Linear	189,814	2	94,907	1,441	,241
	Quadratic	118,361	2	59,180	1,535	,220
Error(Focus)	Linear	7178,900	109	65,861		
	Quadratic	4201,967	109	38,550		

Tests of Between-Subjects Effects

Measure:MEASURE_1

Transformed Variable:Average

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Intercept	39548,238	1	39548,238	420,231	,000
Experience	106,293	2	53,146	,565	,570
Error	10258,076	109	94,111		

Estimated Marginal Means

1. Grand Mean

Measure:MEASURE_1

Mean	Std. Error	95% Confidence Interval	
		Lower Bound	Upper Bound
13,337	,651	12,047	14,626

2. Focus

Estimates

Measure:MEASURE_1

Focus	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
1	23,181	1,274	20,656	25,706
2	11,443	,853	9,752	13,133
3	5,386	,573	4,250	6,521

Pairwise Comparisons

Measure:MEASURE_1

(I) Focus	(J) Focus	Mean Difference (I-J)	Std. Error	Sig.[a]	95% Confidence Interval for Difference[a]	
					Lower Bound	Upper Bound
1	2	11,738*	1,310	,000	9,141	14,335
	3	17,795*	1,333	,000	15,153	20,437
2	1	-11,738*	1,310	,000	-14,335	-9,141
	3	6,057*	,855	,000	4,362	7,752
3	1	-17,795*	1,333	,000	-20,437	-15,153
	2	-6,057*	,855	,000	-7,752	-4,362

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Multivariate Tests

	Value	F	Hypothesis df	Error df	Sig.
Pillai's trace	,629	91,653[a]	2,000	108,000	,000
Wilks' lambda	,371	91,653[a]	2,000	108,000	,000
Hotelling's trace	1,697	91,653[a]	2,000	108,000	,000
Roy's largest root	1,697	91,653[a]	2,000	108,000	,000

Each F tests the multivariate effect of Focus. These tests are based on the linearly independent pairwise comparisons among the estimated marginal means.

a. Exact statistic

9.1.4 DESCRIPTIVE STATISTICS FOR SCORES

Overall Score

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
totalscore	16	60,00	69,15	64,8213	2,50623
Valid N (listwise)	16				

Score for Canter Exercises

Descriptive Statistics

	N	Minimum	Maximum	Mean	Std. Deviation
scorecanter	16	82,00	99,00	88,1250	4,20516
Valid N (listwise)	16				

9.1.5 ANOVA FOR TOTAL SCORES AND EXPERIENCE

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
experience	1	5*	2
	2	4*	4
	3	other/national GP	10

Descriptive Statistics

Dependent Variable:totalscore

experience	Mean	Std. Deviation	N
5*	64,5750	1,50614	2
4*	66,4900	2,09143	4
other/national GP	64,2030	2,66134	10
Total	64,8213	2,50623	16

Tests of Between-Subjects Effects

Dependent Variable:totalscore

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	15,083[a]	2	7,541	1,239	,322
Intercept	44858,343	1	44858,343	7369,117	,000
experience	15,083	2	7,541	1,239	,322
Error	79,135	13	6,087		
Total	67322,929	16			
Corrected Total	94,218	15			

a. R Squared = ,160 (Adjusted R Squared = ,031)

Estimated Marginal Means

Experience

Estimates

Dependent Variable:totalscore

experience	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
5*	64,575	1,745	60,806	68,344
4*	66,490	1,234	63,825	69,155
other/national GP	64,203	,780	62,517	65,889

Pairwise Comparisons

Dependent Variable:totalscore

(I) experience	(J) experience	Mean Difference (I-J)	Std. Error	Sig.[a]
5*	4*	-1,915	2,137	,386
	other/national GP	,372	1,911	,849
4*	5*	1,915	2,137	,386
	other/national GP	2,287	1,460	,141
other/national GP	5*	-,372	1,911	,849
	4*	-2,287	1,460	,141

Pairwise Comparisons

Dependent Variable:totalscore

(I) experience	(J) experience	95% Confidence Interval for Difference[a]	
		Lower Bound	Upper Bound
5*	4*	-6,531	2,701
	other/national GP	-3,757	4,501
4*	5*	-2,701	6,531
	other/national GP	-,866	5,440
other/national GP	5*	-4,501	3,757
	4*	-5,440	,866

Based on estimated marginal means

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable:totalscore

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	15,083	2	7,541	1,239	,322
Error	79,135	13	6,087		

The F tests the effect of experience. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

9.1.6 ANOVA FOR CANTER SCORE AND EXPERIENCE

Univariate Analysis of Variance

Between-Subjects Factors

		Value Label	N
experience	1	5*	2
	2	4*	4
	3	other/national GP	10

Descriptive Statistics

Dependent Variable:scorecanter

experience	Mean	Std. Deviation	N
5*	86,2500	3,88909	2
4*	93,3750	4,02854	4
other/national GP	86,4000	2,45855	10
Total	88,1250	4,20516	16

Tests of Between-Subjects Effects

Dependent Variable:scorecanter

Source	Type III Sum of Squares	df	Mean Square	F	Sig.
Corrected Model	147,038[a]	2	73,519	8,085	,005
Intercept	83258,001	1	83258,001	9156,003	,000
experience	147,037	2	73,519	8,085	,005
Error	118,213	13	9,093		
Total	124521,500	16			
Corrected Total	265,250	15			

a. R Squared = ,554 (Adjusted R Squared = ,486)

Estimated Marginal Means

Experience

Estimates

Dependent Variable:scorecanter

experience	Mean	Std. Error	95% Confidence Interval	
			Lower Bound	Upper Bound
5*	86,250	2,132	81,643	90,857
4*	93,375	1,508	90,118	96,632
other/national GP	86,400	,954	84,340	88,460

Pairwise Comparisons

Dependent Variable:scorecanter

(I) experience	(J) experience	Mean Difference (I-J)	Std. Error	Sig.[a]
5*	4*	-7,125*	2,612	,017
	other/national GP	-,150	2,336	,950
4*	5*	7,125*	2,612	,017
	other/national GP	6,975*	1,784	,002
other/national GP	5*	,150	2,336	,950
	4*	-6,975*	1,784	,002

Pairwise Comparisons

Dependent Variable:scorecanter

(I) experience	(J) experience	95% Confidence Interval for Difference[a]	
		Lower Bound	Upper Bound
5*	4*	-12,767	-1,483
	other/national GP	-5,196	4,896
4*	5*	1,483	12,767
	other/national GP	3,121	10,829
other/national GP	5*	-4,896	5,196
	4*	-10,829	-3,121

Based on estimated marginal means

*. The mean difference is significant at the ,05 level.

a. Adjustment for multiple comparisons: Least Significant Difference (equivalent to no adjustments).

Univariate Tests

Dependent Variable:scorecanter

	Sum of Squares	df	Mean Square	F	Sig.
Contrast	147,038	2	73,519	8,085	,005
Error	118,213	13	9,093		

The F tests the effect of experience. This test is based on the linearly independent pairwise comparisons among the estimated marginal means.

9.2 COUNTING TABLE FOR EVALUATION OF FIXATIONS

Forehand:
- head
- mouth
- poll
- neck
- shoulder
- forearm
- knee
- cannon bone and lower (foreleg)
- breast

Hindquarters:
- croup
- tail
- thigh
- flank
- lower leg
- hock
- cannon bone and lower (hindleg)

Rider:
- head
- torso
- hand
- thigh
- knee
- lower leg

Included exercises

Walk:	
Extended Walk:	11 - PH - Extended Walk
Collected Walk:	12 - HCM - Collected Walk
Canter:	
Collected canter:	1 – AX – Enter in collected canter
	18 – EKAF – Collected Canter
	21 – KA – Collected Canter and Flying Change of Leg
Flying Changes:	19 – FXH – 9 flying changes every 2nd stride
	23 – MXK – 15 flying changes every stride
	25 – X – Flying Change of leg
Extended Canter:	20 – MXK – Extended Canter
Half-passes:	22 – AC – 5 half-passes
Pirouettes:	24 – L – Canter Pirouette left
	26 – I – Canter Pirouette right

9.3 GRAND PRIX 2009 PROTOCOL

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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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.	

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

	Marks	Mark	Correction	Coefficient	Final mark
1. Paces (freedom and regularity)	10			1	
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**				

General Remarks:

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 :

FEI