Effect of rider experience on the jumping kinematics of riding horses

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Submitted 20 June 2005: Accepted 14 October 2005 Research Paper

Abstract
The aim of this study was to examine the influence of an experienced rider and a novice rider on the stride kinematics of experienced riding horses. SVHS video recordings (50 Hz) were made of ten experienced riding horses jumping a 1.05 m-high vertical fence. The horses were randomly assigned to jump the fence under two experimental conditions: ridden by an experienced rider and ridden by a novice rider. Three trials for each ridden condition were analysed, and the effects of the rider type on four kinematic variables were examined using a repeated measures ANOVA. No significant differences were found between the riders for velocity and stride length during the approach, or for the take-off and landing distances from the fence. The results suggest that the rider's body position and body movement had no effect on the horse's jumping kinematics as measured in this study, and that each horse jumped the fence in its own manner, regardless of what the rider was doing. This is contrary to the current belief that a horse's jumping technique is strongly influenced by the rider. These findings have relevance for both horses and riders, in that if an experienced horse does not respond to a rider's instructions as expected, then the implications for training of the horse and the rider are considerable.

Keywords: rider effects; horses; jumping; athletic performance

Introduction
Jumping is a popular equestrian activity that requires significant communication between horse and rider. Riders can communicate and interact with their horses in a number of ways, mainly via changes in the rider's body position and use of the rider's limbs. Other methods of interaction include the use of verbal sounds and through physical contact using a whip. When riders receive training and coaching, particularly early on in their careers, much emphasis is placed on their body position and movement, as these are considered to have a great deal of effect on the way the horse moves.

Little research has been conducted on the effect of the rider on the kinematics of the horse. Biomechanical analysis is a useful technique to quantitatively and objectively measure any athletic performance. Some work has examined the effects of a rider on the flatwork kinematics of horses: for example, the effect of a rider's mass on the locomotion of horses during treadmill exercise has been examined1, and the effects of a rider's mass on the ground reaction forces in trotting horses has been analysed2. A more recent study has examined the effects of a rider on the variability of the horse's gait while trotting on a treadmill3. In equine jumping, some work has examined the effects of a rider on the kinematics of jumping horses by examining the differences between horses jumped loose and ridden. It was found that the rider had a significant effect on the horse's body position at take-off, over the fence and at landing4.

Fewer studies have examined the effect of riders of different calibre on the kinematics of horses. The differences between novice and advanced riders have been examined by analysing the head movement and EMG activity of a number of trunk muscles5. This study found that the novice rider had greater movement of the upper body during the walk and trot. No analysis, however, was conducted on the effects of these riders on the horses' movements. One
research group examined the movement patterns of the rider and horse systems using riders of different abilities. They found that the professional rider-horse system had a more consistent motion pattern than the recreational rider-horse system. Another group examined the differences between a ‘hobby’ rider and a professional rider on the kinematics of a trotting horse, and found that the horses ridden by the professional rider had the highest trotting speed, the longest stride length and the lowest position of the head.

To our knowledge, there is no evidence in the literature of any work examining the effects of riders of different experiences on the jumping kinematics of horses. Experienced riders have a tremendous ability to control the locomotion and movement patterns of their horses. By lengthening or shortening the horse's stride, an experienced rider can position a horse at an optimal distance from the fence at take-off. By controlling the horse's velocity during the approach, the rider can help determine the horse's velocity at takeoff and, therefore, influence the flight time over the fence and the distance jumped. It is generally accepted that riders of different calibre exist and that a good rider can achieve a better performance from a horse than a poor rider, however, the effects of riders of different calibre on the jumping kinematics of horses have not been tested in the literature. The aim of this study was to examine the effects of an experienced and a novice rider on the linear kinematics during jumping in a group of riding horses.

Methods

Ethical approval was obtained before the start of the study from the University of Limerick Research Ethics Committee.

Riders

Two riders were selected for the study. Rider 1 was classified as an experienced rider (75 kg) with extensive show jumping training and experience. This rider had competed successfully at national level show jumping for over 10 years. Rider 2 (63 kg) was classified as a novice rider, and although competent enough to jump safely, did not have any show jumping experience. Visually, the riders were very different in riding style and technique, with the experienced rider being notably more balanced and more in control of the horse than the novice rider.

Horses

Ten horses were used for the study (age: 8 ± 2 years; height: 1.65 ± 0.04 m; weight: 498 ± 39 kg). The horses were selected on the basis of being similar in size and experience. All horses were stabled in the same yard and were used regularly in a large equestrian centre for daily riding lessons. The horses were accustomed to jumping but were not used as competition horses. In accordance with the ethical approval, owners/guardians of the horses consented to their horses being used in the study.

Video recording protocol

Video recordings took place in a large, well-lit indoor arena (90 × 30 m). A halogen light positioned alongside the camera was also used to illuminate the recording area. A single Panasonic AG450 camcorder (Matsushita Electric Corporation of America, Secaucus, NJ, USA) was set up perpendicular to the plane of motion, c. 22 m from the centre of a fence. The zoom facility was used so that the field of view width measured 10 m, which allowed the recording of the last approach stride and the jump stride. Two reference cones were placed 4 m apart on either side of the fence. These were used to scale the coordinate data in the recorded trials. This is a validated method and has been used previously.

A 1.05 m-high vertical fence was used, and was placed mid-way along one side of the arena. Three standard show jumping poles were used: one was used as a ground line, one as a diagonal filler and one was placed horizontally at the 1.05 m height. This fence height was chosen as it was the maximum height that the novice rider was comfortable with. This fence height was also considered substantial for all of the experimental horses to jump, since none of them was a specialized jumping horse. The fence was approached in a clockwise direction and from a right-lead canter.

Videotaping took place over 2 days to avoid the likelihood of fatigue for the horses and the riders. Each horse was randomly assigned to each rider and was ridden once on each day (i.e. each rider rode five horses on the first day and the remaining five on the second day). Riders had a 30 min interval between jumping sessions on each horse.

Each horse received a 15 min warm-up consisting of walking, trotting, cantering and a few practice jumps. SVHS video recordings (50 Hz) were made of the horse and rider jumping the experimental fence. Riders were requested to approach the fence at a canter and in a manner they deemed most appropriate for a successful jump. If the horse jumped the fence in an inappropriate manner, e.g. approached in the wrong lead leg or spooked before the fence, then the trial was repeated until three appropriate trials were collected.

Data analysis

Video recordings were analyzed using Peak Motus 3.2 (Peak Performance Technologies, Centennial, CO,
USA). Four kinematics variables were examined, which are illustrated and defined in Fig. 1. These variables (or related variables) have been shown to be determinants of success in previous studies examining the kinematics of jumping horses\textsuperscript{11,12}. They were selected based on the relative ease of evaluating these variables through qualitative analysis by a trained observer. The distance measurements were calculated from the \(x\) coordinate values of the respective points, e.g. foot placements and fence base.

Descriptive statistics were calculated in Excel 2000 (Microsoft Corporation, Redmond, WA, USA). In order to determine if the data from each horse during each trial were normally distributed, measures of skewness and kurtosis were calculated on the horses’ data for each trial and rider type in SPSS (SPSS Inc., Chicago, IL, USA). \(Z\) values were determined by dividing the raw score for skewness or kurtosis by the appropriate standard error. Data were considered to be normally distributed if the \(Z\) values did not exceed \(\pm 2.0\)\textsuperscript{13}.

Inferential statistics were conducted using a general linear model repeated-measures ANOVA in SPSS. With a within-subjects design such as this, where the same group of subjects (i.e. the horses) is measured for the same variables on a number of occasions, an ANOVA with repeated measures is required to properly analyse any differences in the data\textsuperscript{13}. The statistical design included two independent variables, namely, rider (with two levels) and trial (with three levels) and four dependent variables as defined in Fig. 1. A significance level of \(P < 0.05\) was set for the statistical tests.

**Results**

Each horse attempted the fence three to five times. From the three trials selected as appropriate, all horses cleared...
the fence successfully during each trial for each rider. The tests for skewness and kurtosis for each trial indicated that the results of the horses for both riders were normally distributed for each trial. For further information, the scatter plots in Fig. 2 illustrate the results of the variables for each horse during each rider trial. The descriptive statistics and the results of the ANOVA are provided in Table 1. Although the horses ridden by the experience rider had a slightly faster velocity and a longer stride length during the approach, and took off further from the fence than the horses ridden by the novice rider, no significant differences were found between the riders for any of the measured variables. The $P$ value for trial indicates that there were no learning or fatigue effects.

**Discussion**

This study set out to examine the effect of an experienced rider and a novice rider on the stride kinematics of a group of experienced riding horses. The approach and take-off are critically important in determining the outcome of a jumping effort, and this has been documented many times in the literature. Interestingly, this present study found no significant differences between two riders of contrasting experience and skill for any of the measured variables. The horses in this study approached and jumped the fence in a similar manner for both riders. It has been shown in previous research that a rider can significantly affect the jumping kinematics of young horses attempting just a 1 m-high fence, so there was no reason to assume that the 1.05 m fence height in this study was too small to test this hypothesis. Previous research has indicated that horses have a unique and repeatable technique for jumping over a variety of fence heights, even when ridden by experienced riders, so perhaps, as horses become more experienced, this individual jumping technique becomes more permanent and less susceptible to rider influence.

- The horses used in this study were experienced riding school horses and not competition horses, and perhaps just did not respond (as expected) to the instruction or absence of instruction from each rider. Considering that the kinematics of the horses was consistent for each rider (ANOVA test for trial effect was insignificant), it does, therefore, seem likely that the horses jumped the 1.05 m experimental fence successfully and consistently regardless of the rider’s movements or instructions (this is visually evident from the scatter plots in Fig. 2). This suggests that changes in the body position of the rider do not have a significant effect on some of the gross movements of the horse during jumping. This is an interesting finding considering that the rider’s body position and movement are focused upon to a large extent during jumping training of the rider. There is a possibility that the riding school horses may be more accustomed to compensating for unpredictable movements of novice riders and ignore the poor commands and signals given by these riders.

- Because of the limitations of the novice rider, it was not possible to test the difference between the riders over a higher fence. Although this might have meant that some of the horses were jumping submaximally and could perhaps tolerate any mistakes made by the novice rider, it does not explain the fact that the horses approached the fence with a similar speed and took off from a similar position with both riders. It has been shown in previous research that a rider can significantly affect the jumping kinematics of young horses attempting just a 1 m-high fence, so there was no reason to assume that the 1.05 m fence height in this study was too small to test this hypothesis. Previous research has indicated that horses have a unique and repeatable technique for jumping over a variety of fence heights, even when ridden by experienced riders, so perhaps, as horses become more experienced, this individual jumping technique becomes more permanent and less susceptible to rider influence.

- The body mass of the experienced and novice riders equated to c. 12 and 15% of the horses’ body masses, respectively. It is not known what effect a 3% difference in weight would have on the jumping kinematics of the horse; however, for this study, it was not deemed particularly important as the stamina and endurance of the horses were not considered as factors. In any case, evidence in show jumping indicates that the weight of a rider is relatively unimportant to performance, since men and women compete on an equal basis despite the differences in body size and strength.

- It is possible that the difference in rider experience was not great enough to have an effect on the horses, but this is unlikely considering the previous

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**Table 1** Descriptive statistics (mean ± SD) and $P$ values for the measured variables

<table>
<thead>
<tr>
<th>Variable</th>
<th>Unit</th>
<th>Experienced</th>
<th>Novice</th>
<th>Rider $P$ value</th>
<th>Trial $P$ value</th>
</tr>
</thead>
<tbody>
<tr>
<td>$V_{\text{APPROACH}}$</td>
<td>m s$^{-1}$</td>
<td>6.08 ± 0.53</td>
<td>5.80 ± 0.63</td>
<td>0.271</td>
<td>0.926</td>
</tr>
<tr>
<td>$S_{\text{APPROACH}}$</td>
<td>m</td>
<td>2.56 ± 0.53</td>
<td>2.49 ± 0.38</td>
<td>0.612</td>
<td>0.837</td>
</tr>
<tr>
<td>$L_{\text{HTO}}$</td>
<td>m</td>
<td>1.52 ± 0.38</td>
<td>1.49 ± 0.31</td>
<td>0.772</td>
<td>0.846</td>
</tr>
<tr>
<td>$T_{\text{FLAND}}$</td>
<td>m</td>
<td>2.09 ± 0.31</td>
<td>2.06 ± 0.36</td>
<td>0.760</td>
<td>0.459</td>
</tr>
</tbody>
</table>
histories of the riders and the notable visual differences in the riders’ styles and abilities. Nevertheless, these differences in rider style did not have any effect on the kinematic variables measured over a single fence. It may also be possible that the riders had more of an influence on the horses in the strides prior to the point where data collection began (i.e. preceding the final approach stride and jump stride), and this may have implications for riders in negotiating a course or a combination of fences rather than a single fence. This is an aspect that could warrant further research.

Finally, it may be that a single novice or experienced rider is not aptly representative or prototypical of all novice or experienced riders, and that the horses may respond differently to a cohort of riders of varying ability. Perhaps this is an area that also warrants further research; however, previous work has shown that a group of horses (n = 8) can respond differently to a single rider4, so there is no reason to believe that the horses in this study could not have responded differently to the riders involved.

Previous work has shown that the horse’s gait pattern is less variable with an experienced rider compared with a novice rider5; however, this theory was not supported in this study. The relevance of these results may be considerable for equine jumping research and training, but at this stage it may be wise to err on the side of caution and limit our conclusions to groups of riding school horses, as other groups of horses (e.g. novice horses, competition horses) may respond differently to the commands and instructions of a rider. This is an aspect that should be considered in future similar studies. However, if we accept the theory that as horses become more experienced at jumping they become less influenced by the rider’s instructions, then there are consequences for the training of older horses and also for the training of riders. If ‘seasoned’ horses do not respond to the rider’s instructions and simply jump in the manner they choose, then training regimes may have little benefit for either the horse or the rider. Of course, for the novice rider, an experienced horse is of great benefit. However, for the more advanced riders wishing to improve their riding ability and skills, a horse that does not respond to their commands may not prove to be very useful.

Acknowledgements

The authors wish to thank Clonshire Equestrian Centre for providing the venue and the horses, and also Karen Gardiner and Jennifer Dineen for assistance with the data collection.

References