THE CHANGES IN EFFORT DISTRIBUTION FROM NOVICE TO EXPERIENCED PERFORMERS IN THE TRIPLE JUMP

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This study investigated the ratios of the three phases in triple jumping by novice (n=8) and experienced (n=5) athletes during indoor competition. Video data were analysed to determine the phase distances for 58 competitive triple jump performances. Phase ratio percentages were calculated for each of the trials. There were significant differences in the step phase percentage (p<0.05) and jump phase percentage (p<0.05) for the two groups. At the group level, novice jumpers appeared to favour a jump-dominated strategy, whilst the technique was hop-dominated for experienced jumpers. Using pooled data masked individual variations in strategy and so these group results should be viewed with caution. Future research will focus on the longitudinal development of individual performers and the mechanics of the associated changes in effort distribution.

KEYWORDS: athletics, jumping technique, phase ratios.

INTRODUCTION: There has been a variety of different techniques employed by triple jumpers in a quest to achieve the greatest possible distance. The problem facing the triple jumper is that, unlike a long jumper who exerts a maximal effort in order to attain maximal distance, the triple jumper gains maximum distance by distributing effort across all three phases most effectively (Larkins, 1990). The triple jumper must therefore utilise the most effective apportionment of these phases to attain the best outcome. Each of the phase distances can be expressed as a percentage of the total jump distance, thereby establishing the hop, step and jump percentages. These percentages can be used to ascertain the phase ratio that was used during the complete triple jump. The use of phase ratios has led to a quantifiable classification of jumping techniques;

Hop-Dominated: the hop distance is at least 2% of the actual distance greater than the next longest phase

Jump-Dominated: the jump distance is at least 2% of the actual distance greater than the next longest phase

Balanced: the longest phase distance is less than 2% of the actual distance greater than the next longest phase distance (Hay, 1992)

The purpose of this study was to investigate the phase ratios used by novice and experienced triple jumpers during indoor competition with the overall aim of informing future athlete development and coaching practice. This study formed part of an ongoing research project and results were integral in directing future methodological procedures.

METHOD: Thirteen subjects participated in a competition at the National Indoor Athletics Centre in Cardiff. Eight were in their first year of competitive triple jumping, while the other five had at least three years experience. Video images of 58 triple jump trials were collected using four digital camcorders (Sony, DSR-PD100AP, Japan) located alongside two parallel runways as shown in Figure 1. Each camera was positioned 5.3 m above ground level at a distance of 8.5 m from the centre of the two jumping runways. The cameras were angled downwards at approximately 30° allowing the track surface to be defined as a two dimensional (2D) reference plane. All cameras were operating at 50Hz with electronic shutter speeds of 1/1000 s. Camera 1 was placed to record the final stride of the approach run and the take-off for the hop phase for athletes using the 9 m, 11 m and 13 m take-off boards and camera 2 captured the hop phase landing and step phase take-off for these athletes. Camera 2 also captured the last stride of the run-up and hop phase take-off for athletes using the 7 m board. Camera 3 captured the hop phase landing and step phase take-off of athletes using the 7m board and also the step phase landing and jump phase take-off for all athletes. Camera 4 recorded the landing of the jump phase.

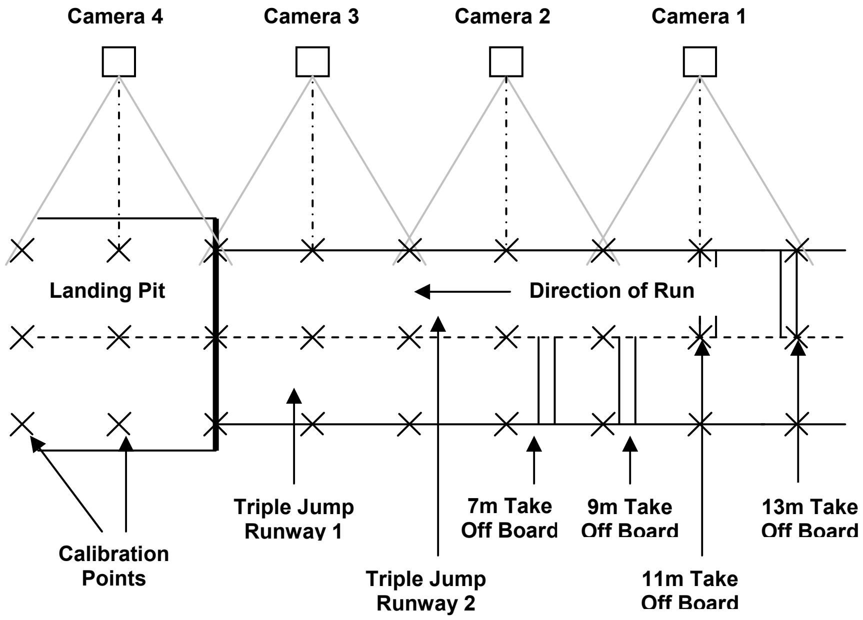

Figure 1: Plan View of the Experimental Set-Up

Nine circular markers were placed at known locations within the field of view of each camera to facilitate camera calibration. Selected calibration and movement video images were digitised using the Target system (Kerwin, 1995). The centre of each circular control point was digitised for ten consecutive fields and the subsequent calibration coordinate data used to calculate the eight parameters for two-dimensional direct linear transformation (DLT) (Kwon, 1999). Reconstruction error estimates were obtained for the two-dimensional coordinates of the calibration points in each camera view. Positional accuracy estimates were obtained by reconstructing known points which had not been included in the reconstruction process. Heel and toe markers in consecutive images (typically 4) of each foot contact were digitised. The object-space coordinates of these points were obtained using the 2D DLT reconstruction. The horizontal displacement values for the heel and toe at each ground contact were used to calculate the phase distances for the hop (from the horizontal toe position of the contact foot at the hop take-off to the horizontal toe position of contact foot at the hop landing), step (from the horizontal toe position of contact foot at step take-off to the horizontal toe position of the contact foot at the step landing) and jump phases (from the horizontal toe position of the contact foot at the jump take-off to the horizontal position of the mark made in the sand that is closest to the take-off board). The phase ratios were then determined for each trial and corresponding jumping styles were attributed to each subject. In order to compare results between the experienced and novice groups, the phase ratio data were averaged and the standard deviations calculated. Based on the mean data for each group a Mann-Whitney test was used to establish any significant difference that existed.

RESULTS AND DISCUSSION: Reconstruction error estimates were 0.009 m (x) and 0.003 m (y) within a field of view of 2.5 m x 4.5 m. Positional accuracy in the direction of the triple jump was ± 0.004 m. The total jump distances in the competitive trials ranged from 8.82 m to 15.11 m. As expected, there was a significant difference (p<0.05) in the mean triple jump distance between the experienced performers (12.52 m ± 1.58 m) and the novice group (10.72 m ± 0.78 m). The mean and standard deviation phase percentages for both groups can be seen in Figure 1.2. There were significant differences in the percentages between groups for the step phase (p<0.05) and the jump phase (p<0.05) but not for the hop phase (p=0.34).

The results support the suggestion that novice triple jumpers compromise their step phase (Larkins, 1990); either consciously in order to maintain horizontal velocity for the final phase, or as a result of excessive 'yielding' following a hop phase for which they are not yet physically prepared to rebound from. In either of these scenarios, the step phase becomes a simple link between the hop and the jump phases as opposed to a phase that notably contributes to the total jump distance. This style of jumping results in a jump-dominated phase ratio performance. The experienced triple jumpers displayed a much greater step phase percentage, which in turn reduced the associated jump phase percentage. This contrasting method of jumping results in hop-dominated performances. Ultimately, this method of jumping appears to produce greater competitive results.

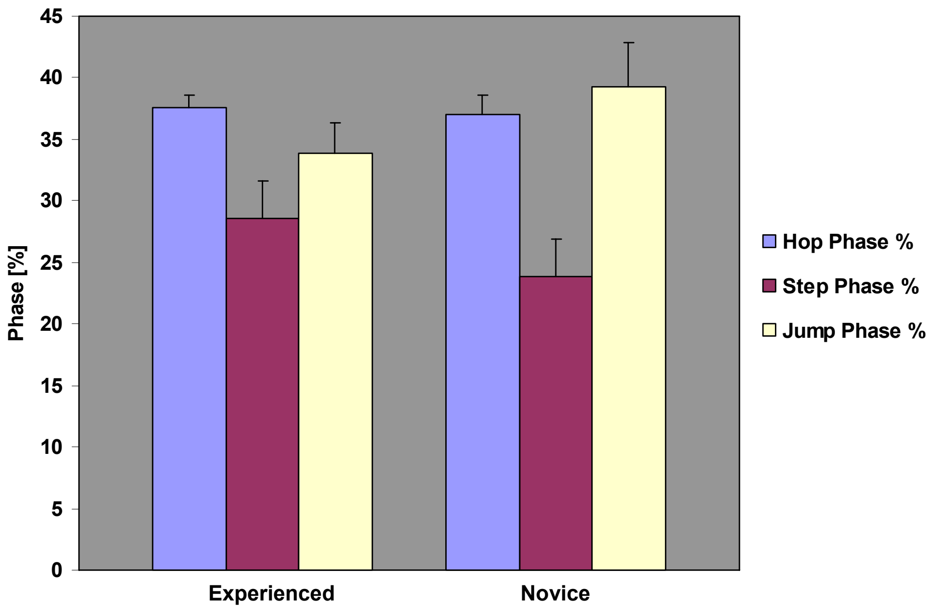

Figure 2: Phase percentage values

Using the inferential statistical data presented, it would be common practice to generalise the findings to a wider population. The primary disadvantage of using a pooled data approach is that individual differences are often overlooked. It has been argued that grouped data have limited value because each person possesses his or her own "signature" and it therefore makes little sense to average performances across individuals (Kelso, 1995). While the mean data would indicate that novice jumpers use a jump-dominated configuration, two of the novices used a hop-dominant style, while a further novice used a balanced technique. Predictions based on the group data pertain to an average performer and thus can mask values for individual athletes. It is on this basis that Dufek et al. (1995) highlighted the importance of evaluating group performance data with caution. In this case it would seem presumptuous to suggest that all novice triple jumpers utilise a jump-dominated pattern of triple jumping. The physical and mental preparation of the performer will be influential in the jumping strategy that is employed, and while they are novices in respect to the time they have spent triple jumping, they are also at differing stages of physical and technical development. A measure of these characteristics would be beneficial in assessing trends in effort distribution with respect to experience.

CONCLUSION: While initial findings indicate that experienced triple jumpers utilise a hop-dominated jumping strategy and novices use jump-dominated techniques, there are individual performers within each group who do not follow these trends. The pooled data from this cross-sectional study should therefore be viewed cautiously.

In future work the focus will be on the longitudinal development of individuals and on the mechanics of the associated changes in effort distribution. Furthermore, in order to better inform coaching practices, it is necessary to explain the relative contributions from technical and physical factors in jumping style. Future research will incorporate measures of physical development alongside the assessment of changes in technique.

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