

THE OPTIMAL CONTRIBUTION OF THE PHASE DISTANCES IN THE TRIPLE JUMP: NOVICES VERSUS ELITES

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Over the years, many investigators have studied how triple jumpers apportion the phase distances. This information is important to the researcher and coach because it enables them to determine on which phase jumpers place their emphasis in order to achieve maximum performance. These "ratio studies" point to the importance of balancing the maintenance of momentum by attaining an optimum distance on each phase (Doherty, 1976). The question still remains, however, as to whether there is an optimal apportionment that would allow all triple jumpers to achieve maximum performance.

Nett (1961) suggested that the optimal percent contribution of each phase should be 35%, 30%, and 35% for the hop, step, and jump respectively. He stated that when the hop contribution was greater than 38%, the horizontal takeoff velocity decreased considerably. He also stated that when the hop contribution was between 20% and 30%, there was no decrease in the horizontal velocity, but the athlete could not jump as far. Below is a list of researchers and the means of the percent phase contributions they found for elite male triple jumpers.

Researcher	HOP	STEP	JUMP
Milburn (1979)	36.3%	31.3%	32.4%
Smith and Haven (1982)	33.6%	28.9%	37.5%
Fukashiro et al.(1981)	36.9%	29.1%	34.0%
Hay and Miller (1985)	35.4%	29.4%	35.3%

As can be seen from the findings listed above, the mean contribution of the phase distances varied with each study. Hay's and Miller's (1985)

findings came closest to the contributions suggested by Nett (1961) as being optimal.

So far, no studies have been able to determine whether an optimal apportionment of the phase distances actually exists. Most modern coaches and researchers believe, however, that if it does exist, it is embodied in two styles of triple jumping, the Polish Style and the Russian Style. McNab (1968) characterized the Polish Style as having phase contributions of approximately 35%, 29%, 36% for the hop, step, and jump distances, respectively. The Polish Style triple jumpers use great approach speed and keep their trajectory low during the hop and step flights. This seems to allow them to maintain momentum throughout the performance so that they can place their emphasis on the jump phase (Doherty, 1976). McNab characterized the Russian Style as having phase contributions of approximately 39%, 30%, and 31% for the hop, step, and jump phases, respectively. The Russian Style triple jumpers acquire their longest phase distance during the hop phase. They also attempt to achieve a long step distance. Due to diminished momentum, however, the jump phase is usually shorter than the hop phase in the Russian Style (Doherty, 1976).

In their study of the twelve finalists in the triple jump at the 1984 Olympic Games, Hay and Miller (1985) also categorized the performances of the finalists into these two styles. The average phase contributions for the seven finalists who used the Russian Style was 36.4%, 29.5% and 34.2% for the hop, step, and jump respectively. They found that "none of the seven, however, recorded ratios in which the hop phase was as overwhelmingly dominant as suggested by McNab for the Russian technique" (p. 189). They, also found that the remaining five triple jumpers who used the Polish Style had average phase contributions of 34.4%, 29.3% and 36.3%. These values were close to those suggested by McNab (1968).

In spite of the extensive research that has been devoted to studying phase contributions, many prominent coaches and researchers (Ganslen, 1964, and Bullard & Knuth, 1977) agree with Dyson's (1977) assertion that "the basic principle in the triple-jump is that no one phase must be stressed to the detriment of the overall effort."

Previous triple jump studies have focused on the performance of elite or well trained triple jumpers only. Most coaches, however, are directly involved with novices. In spite of this, no triple jump study has ever been conducted using novices as subjects. The purpose of this study was to determine how novices apportion the phase distances and

to compare these findings to the performances of elite triple jumpers. Such a study should help coaches better understand the performance of their novice jumpers and perhaps, throw some further light for researchers on the optimal contribution of the phase distances.

Procedures

Selection of Novice Triple Jumpers

Seven female interscholastic track and field athletes volunteered for this study. The only restriction placed on their participation was that they must not have had prior training in the triple jump.

Training Procedure for Novices

Because each of the jumpers competed in various other events during the season, the subjects' triple jump training was limited to a maximum of one half hour per day four days per week for a period of one month. Before the jumpers were given any instruction, they were shown films of triple jump performances to introduce them to the event. Through personal experience as a competitor, coach, and researcher, the investigator was able to point out examples of good triple jump technique.

Each training session attempted to develop the following skills: 1) basic running mechanics, 2) basic jumping mechanics, 3) proper approach run technique as determined by the researcher, and 4) proper triple jump technique. Details of how these skills were developed will be presented in a future article. The distance of the approach run for this study was set by the researcher at ten steps. The purpose of limiting the length of the approach run was to enhance coordination and timing during the subsequent takeoff phases and to reduce the risk of injury.

For practice jumps, the distances for the three phases were also dictated by the researcher. This training procedure reinforced the philosophy held by many coaches that no phase distance should be stressed to the detriment of the overall effect. As illustrated in Figure 1, flags of shoulder height were evenly spaced along the side of the landing area. For example, if the goal was to jump 24 feet, each flag was spaced 8 feet apart.

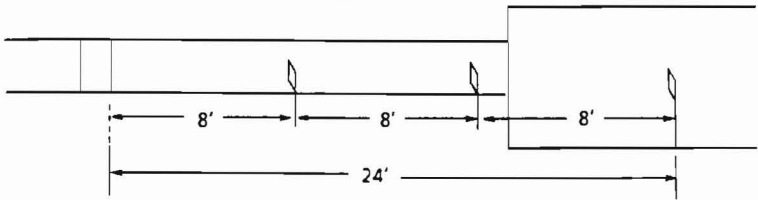


Figure 1 -- Placement of flags for even ratio practice jumps.

Each jumper had to meet the following performance level before she was allowed to participate in the study: 1) she had to be able to perform consistently ten step approach triple jumps at 100% effort and 2) she had to be able to perform practice jumps with even ratio jumps from a 1 step, 4 step, and 6 step approach run.

Jumping Protocol

The site for this study was Eastern Michigan University's outdoor all weather tartan track. The women's triple jump takeoff board was 8.23m (27 feet) away from the pit, a distance that would cause most beginning high school female jumpers to struggle to reach the sand. In order to alleviate this problem, the women's takeoff board was ignored and the distance from the takeoff board to the beginning of the landing pit was adjusted so that the jumpers would comfortably reach the sand.

A road construction cone was substituted for the takeoff board and was placed 6.75 m from the beginning of the landing pit. It was used only as a general reference mark as to where the first takeoff might begin. The jumpers were free to takeoff anywhere their final approach step landed. No fouls were recognized. This freed the jumpers from the inhibitions caused by the fear of fouling and enabled them to concentrate fully on acquiring maximum distance. An observer marked the point of the first takeoff for each jumper, and the total distance was measured from that point to the mark in the sand nearest to the point

concentrate fully on acquiring maximum distance. An observer marked the point of the first takeoff for each jumper, and the total distance was measured from that point to the mark in the sand nearest to the point of takeoff. This distance was used only to give the jumpers an indication of how well they were performing.

Each jumper performed four jumps. Because some of the takeoffs and landings were outside the field of view of the cameras, they could not be used in the analysis. A total of 24 jumps were used for data analysis.

Filming Procedures

As shown in Figure 2, four Locam 16 mm high speed pin registered motion picture cameras were used to collect the data for this study. This camera setup allowed the researcher to collect phase distance data as well as data for other variables of interest to the researcher. Three cameras were placed perpendicular to the field of view and recorded a sagittal view of the last five approach steps as well as the entire jump. The three side cameras were positioned 39.3m from the inner edge of the runway. This distance created an image size that was adequate for data acquisition. The positioning of these cameras caused the fields of view of each of the three cameras to overlap. All three cameras were leveled and fixed securely on a tripod 1.05 m above the ground. The fourth camera recorded a frontal view of the entire approach and jump.

All cameras were set to operate at 100 fps with a shutter angle of 120 degrees. The actual filming speed was calibrated from timing boxes that were placed in the field of view. A meter stick,

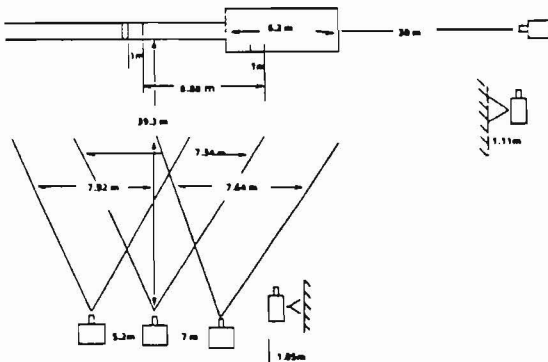


Figure 2 - Camera Setup.

held in the center of the runway, was filmed by both the sagittal and frontal view camera prior to filming the jumpers. This horizontal reference measure was used to convert film image distances to real life distances.

The Quantification of the Phase Distances

The phase distances were measured manually from the film images. Each phase distance was determined by measuring the distance between the point of toeff and the point of touchdown. These phase distances are shown in Figure 3. The image distances were then converted to real life distance by a linear multiplier conversion factor.

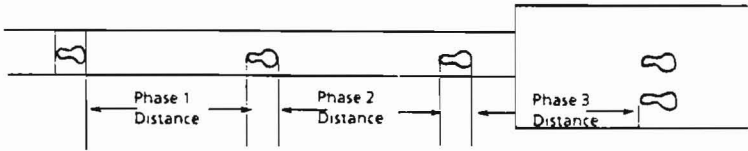


Figure 3 -- Measurement of phase distances.

Results and Discussion

As shown in Table 1, the mean total distance jumped for the Novice jumpers in this study was 7.92 m (26 ft). The best jumps for each individual ranged from 8.83 m (29 ft) to 7.62 m (25 ft).

Table 1 -- Novices: Means and standard deviations and the mean percent contributions of the phase distances.

	HOP	STEP	JUMP	TOTAL
Mean	2.69m	2.01m	3.22m	7.92m
S.D.	0.19m	0.18m	0.32m	
Contribution	33.9%	25.4%	40.7%	

In spite of being trained to perform with evenly apportioned phase distances, the Novices' mean phase contribution of 33.9%, 25.4%, and 40.7% showed that their phase distances were clearly different from each other. This observation was supported by the computed F value which showed convincing evidence of statistically significant difference, $F(2,69) = 153.39, p < .001$. From the confidence intervals shown in Figure 4, it can be inferred that in spite of the small sample size ($n = 7, k = 24$) the true mean phase distances for novice female triple jumpers are very close to the mean phase distances reported for the Novice girls used in this study. As shown, we can be 95% confident that the true means fall within ± 0.07 m, ± 0.08 m, and ± 0.14 m of the reported hop, step, and jump distances respectively.

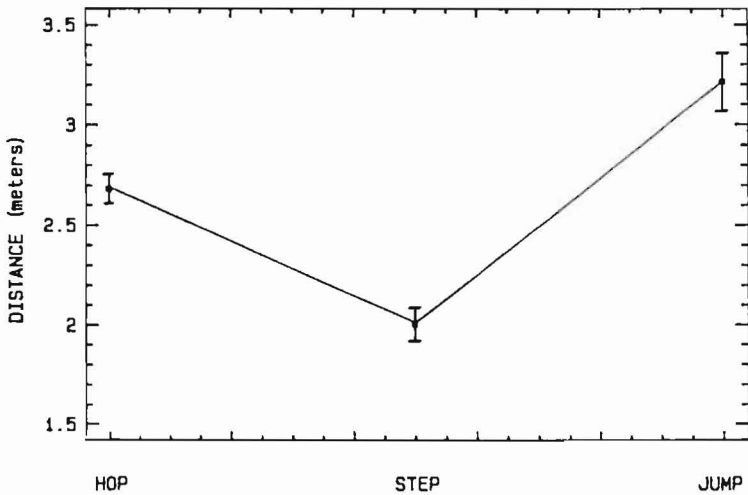


Figure 4 -- Mean phase distances for Novices within 95% confidence intervals.

The Novices' medium-short-long pattern resembled the Polish Style of triple jumping. A jump contribution of 40.7%, however, far exceeded any reported findings for Polish style elite triple jumpers. By

comparison, the mean jump contribution for the 1984 Olympic finalists who used the Polish style was only 36.3% (Hay and Miller, 1985). The Novices' total reliance upon the Polish Style becomes evident in view of the fact that of the 24 jumps analyzed, the jump distance was farthest in all cases.

Coaches generally acknowledge that achieving a long step distance in comparison to the hop and jump distances is very difficult regardless of skill level. It usually takes years of training in order to develop the muscular strength, power, and coordination needed to make an efficient transition from the hop landing to the step takeoff. The Novices' step contribution of 25.5% was weak in comparison to the 29.3% step contribution of their Polish Style "84" Olympic counterparts. This 4% difference between the skill levels suggests that in order to attain the same total distance of 7.92 m while using the Elites' 29.3% step contribution, the Novices would have had to step .30 m or a foot farther than they did. The inadequacy of the Novices' step phase may indicate that they used this phase only as a link between the hop and jump phases.

Conclusions

The findings for this study suggest that whereas elite triple jumpers can perform well using either the Polish Style or the Russian Style, novices may be limited to an exaggerated Polish Style. As shown in this study, this limitation is primarily the result of their inability to execute an effective step phase. It appears that novices use the step phase merely as a link and fail to understand that it is a vital component of the complete performance. Understanding this limitation, coaches can focus their attention on developing training procedures designed 1) to make the jumper aware of the objective of the step phase and 2) to teach the jumper how it should be executed.

In addition to the lack of understanding of the function of the step phase, novices also lack the physical strength and skill needed to be able to rebound from the stress of landing from a long hop. Therefore, in order to maintain horizontal momentum as well as to avoid injury, they hold back during the first two takeoffs and maximize their effort during the third takeoff. The novices' ability to rebound from the hop landing can be improved by increasing the strength and power of the ankle, knee, and hip extensors.

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Initially, novices may be limited to the exaggerated Polish Style. With additional training and maturity, however, they will be able to develop other strategies; i.e., the Russian Style as is performed by many of their elite counterparts. Overall, for the researcher, the results show that the optimal contribution of the phase distances may be a function of the jumper's strength, speed, and skill level.

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