

PREDICTORS OF HORIZONTAL VELOCITY IN THE TAKEOFF OF THE LONG JUMP AND TRIPLE JUMP HOP

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Of the four types of jumping events in track and field (long jump, triple jump, high jump, and pole vault), the approach for the long jump and triple jump is a purposeful preliminary to the projection of the body for horizontal distance. Collegiate athletes are often asked to perform in multiple events because of the importance of team scoring. A common two event combination is the long jump and triple jump since both events' prime objective is to project the body for maximum horizontal distance. Although takeoff technique differs between the two events, the long jump and triple jump combination share horizontal velocity as the most important parameter in determining the distance achieved (Adams, 1975; Bosco, 1976; Brancazio, 1984; and Kreighbaum and Barthels, 1985).

The long jump consists of a running approach, a one foot takeoff from a wooden takeoff board and a two footed landing into a sand pit. Similarly, the triple jump consists of a running approach, however the athlete performs three takeoffs in succession and subsequently lands in a sand pit. The athlete hops from one foot, lands on the same foot, steps onto the opposite foot, and, finally jumps into a pit similar to the long jump. Recorded distance for each event is noted by the perpendicular distance from the edge of the takeoff board closest to the landing pit to the marks made by the jumper in the sand closest to the takeoff board. Therefore, the ultimate goal in both events is similar, to project the body for maximum horizontal distance. However, the goals in the takeoff for the long jump and the hop phase of the triple jump are each unique, and, therefore, athletes who perform in both horizontal jumps must make alterations in the technique to achieve maximum proficiency at this two event combination.

During the long jump takeoff the athlete's goal is to achieve the

greatest horizontal distance possible. However, during the hop (first) phase of the triple jump, the individuals' techniques must compromise horizontal distance while maintaining horizontal velocity for the final two phases (step and jump) in the event (Bober, Marron, 1982; Tellez, 1983).

Although previous investigators have described and analyzed the long jump and triple jump, very little work seems to have been done to analyze the takeoff for each event. The current investigation was undertaken to elucidate parameters that contribute to the athletes' horizontal velocities during takeoff in each event.

Four collegiate track and field athletes skilled in both the long jump (jumps of 23'10" to 26'4") and the triple jump (jumps of 48'3" to 55'7") were filmed during a regularly scheduled intercollegiate indoor track meet. One LOCAM high speed camera (100 fps) was placed in line with the takeoff board and perpendicular to the athletes' plane of motion. The film was subsequently digitized with a Numonics Corporation digitizer and the data generated were analyzed with a Honeywell 66/DPS computer.

The following variables were recorded because of their prominence in the reviewed literature:

1. horizontal velocity prior to takeoff (criterion parameter).
2. horizontal velocity after takeoff (criterion parameter).
3. time of foot contact with the takeoff board.
4. length of penultimate stride.
5. length of final stride.
6. vertical velocity after takeoff.
7. angle of trunk inclination at takeoff.
8. maximum knee flexion during takeoff.
9. projection angle of takeoff.
10. center of gravity location at takeoff.

A stepwise regression was used to determine which, if any, of the selected parameters could predict a criterion variable. Since horizontal velocity is the most important factor affecting distance in both the long jump and the triple jump, horizontal velocity before and after takeoff were chosen to act as criterion variables.

Horizontal velocity at before takeoff in the long jump was best predicted by the penultimate stride length, which accounted for 46% of the variance in pre-takeoff horizontal velocity ($p < .05$). The remaining

eight predictors accounted for an additional 14% of the variance and were not significant ($p > .05$).

Triple jump horizontal velocity at before takeoff was also best predicted by the penultimate stride length, which accounted for 35% of the variance ($p < .05$). The other eight predictors accounted for an additional nine percent and were not significant ($p > .05$).

TABLE 1
Step-wise Regression
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	Parameter	Predictor	R	BETA	r	
LJ	HVBTO	PL	.46	.372	.70	**
TJ	HVBTO	PL	.35	.457	.62	**
LJ	HVATO	ATO	.27	-.321	-.55	**
TJ	HVATO	TOB	.35	-.246	-.63	**

** significant at ($p < .01$)

abbreviations:

LJ: long jump

TJ: triple jump

HVBTO: horizontal velocity prior to takeoff

HVATO: horizontal velocity after takeoff

ATO: projection angle of takeoff

TOB: time of foot contact with the takeoff board

With horizontal velocity after takeoff as the criterion parameter, the long jumpers' angle of takeoff accounted for 27% of the variance in post takeoff horizontal velocity ($p < .05$). The additional eight predictors accounted for another two percent of the criterion parameter's variance and were not significant ($p > .05$).

Triple jump horizontal velocity after takeoff was best predicted by the time of foot contact with the takeoff board, accounting for 39% of the variance of the criterion parameter, and was significant ($p < .05$). The remaining eight predictors accounted for an additional 38% of the variance but were not significant ($p > .05$).

These results indicate that in order to maximize horizontal velocity prior to takeoff in both events, athletes do not need to make any

adjustments in the approach between the long jump and triple jump. The importance of achieving optimum angle of takeoff to maximize distance in the long jump has been well documented in previous investigations. The current study suggests that the angle of takeoff was the most decisive parameter in determining the athlete's horizontal velocity following takeoff ($R^2 = .27$, $r = -.55$).

During the triple jump hop, the athlete attempts to project the body for horizontal distance while maintaining horizontal velocity for the step and jump phases. Previous studies have advocated "active foot placement" on the board during hop takeoff. Moreover, the triple jumper does not want to achieve a higher takeoff trajectory than that which occurs by simply running off of the takeoff board or a detriment in the step and jump phases will result. This investigation concluded that the time of foot contact with the takeoff board is the most critical factor in determining the triple jumper's horizontal velocity following takeoff ($R^2 = .35$, $r = -.63$).

Even though the ultimate goal in both the long jump and triple jump is similar, there are some adjustments that need to be made in the takeoff for the two events to achieve maximum proficiency. Athletes and coaches who understand the differences and similarities in the two events will be more proficient and successful at performing and teaching this combination of events.

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