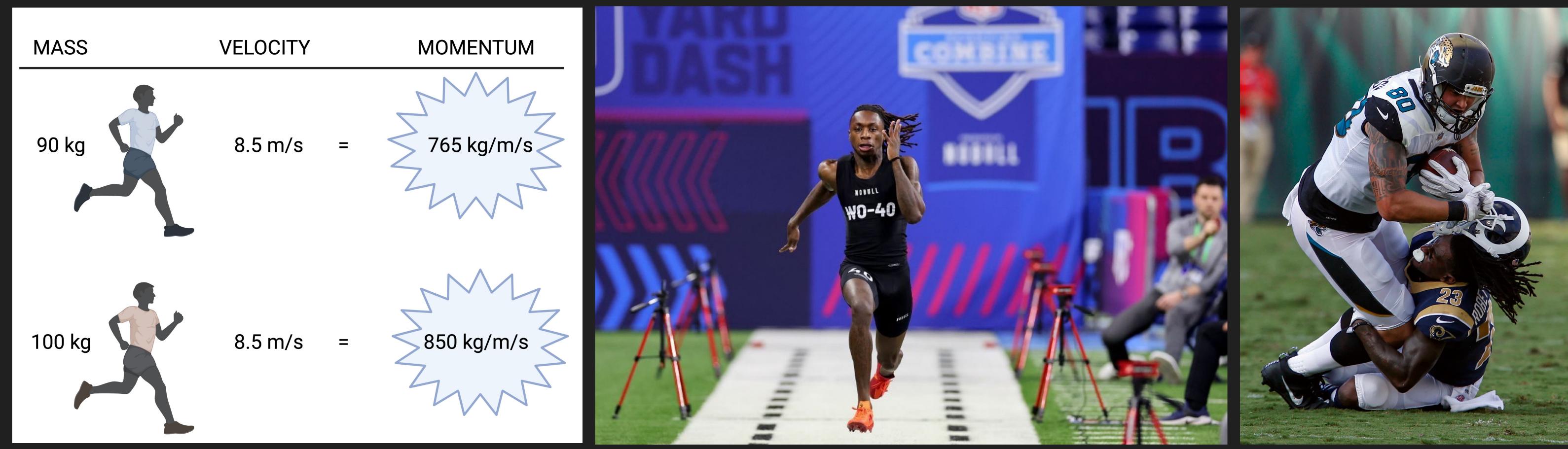# DIFFERENCES IN MOMENTUM AND SPEED PERFORMANCE BETWEEN POSITIONS AMONG DIVISION I COLLEGIATE FOOTBALL PLAYERS

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## Abstract

### Background

Collision sports, such as football, are influenced by the colliding players' relative momentum (i.e., body mass x velocity). There is evidence that momentum can help discriminate across player levels and positions in collision sports. However, to what extent momentum can be used to distinguish positional differences and player success is unclear.

### PURPOSE

This study determined if time and momentum for sprint and agility drills could be used to delineate between starter and non-starter NCAA Division I college football players.

### METHODS

Data from 512 collegiate football players who completed the 40-yard dash (40-m), ProAgility (ProA), and L-Drill were analyzed. Momentum was calculated using body mass and the average speed from each test. Players were grouped into three positions: Skill, mid, and big. Data were analyzed with univariate repeated measures analysis of variance (ANOVA) with Fisher's Least Significant Difference (LSD) post hoc to compare differences in time and momentum between starters and non-starters within each positional group for the 40-m, ProA, and L-Drill. Between-group effect sizes were calculated using Cohen's d and were interpreted using the Hopkins scale. Partial eta squared ($\acute{\eta}2$) and observed power were reported for main effect comparisons by position. Receiver Operating Characteristic Curves (ROC) were performed to establish cutoff values to distinguish starters from non-starters. An area under the curve (AUC) less than 0.5 denotes no ability to discriminate between starters and non-starters, while 0.7-0.8 is acceptable, 0.8-0.9 is excellent, and >0.9 is outstanding.

### RESULTS

Univariate ANOVA revealed significant differences for both time and momentum between starters and non-starters for all tests in all positions (See Table 1A and 1B), except the big positions during the L-Drill (p=0.06). Significant and poor ROC curves were noted for all tests for time. Significant ROC curves ranging from acceptable to excellent were noted for momentum in the 40-m and ProA tests across positional groups, while near-acceptable ROC curves were noted for the L-drill across all positions (See Table 1C). For 40-m momentum cutoff values of >690.3 kg·m·s-1 and >881.1 kg·m·s-1 were established for starters for the skill and big positions, respectively. In terms of the ProA test, a cutoff value of >385.3 kg·m·s-1 was established for the skill position, while the cutoff values of >428.2 kg·m·s-1 and >493.5 kg·m·s-1 were established for starters for the mid and big positions, respectively.

### CONCLUSIONS

These findings suggest that momentum tracking across position groups should be more heavily relied on when deciding starter vs. non-starter status.

### PRACTICAL APPLICATION

Coaches can make decisions regarding starting players based on these performance cutoff values for momentum.

## Table Results

### A. Univariate ANOVA Results

| | Test | Position | F | Sig. | ή2 | Obs. Power |
|---|---|---|---|---|---|---|
| Time | 40-yard sprint | Skill | 37 | <0.001† | 0.186 | 1.000 |
| | | Mid | 24.066 | <0.001† | 0.103 | 0.998 |
| | | Big | 9.793 | 0.002† | 0.075 | 0.874 |
| | Pro-Agility | Skill | 35 | <0.001† | 0.182 | 1.000 |
| | | Mid | 5.73 | 0.018† | 0.028 | 0.664 |
| | | Big | 6.147 | 0.015† | 0.05 | 0.691 |
| | L-Drill | Skill | 29 | <0.001† | 0.154 | 1.000 |
| | | Mid | 11.792 | 0.001† | 0.055 | 0.928 |
| | | Big | 3.597 | 0.06‡ | 0.029 | 0.469 |
| Momentum | 40-yard sprint | Skill | 22 | <0.001† | 0.121 | 0.997 |
| | | Mid | 18.614 | <0.001† | 0.082 | 0.990 |
| | | Big | 21.532 | <0.001† | 0.152 | 0.996 |
| | Pro-Agility | Skill | 23 | <0.001† | 0.126 | 0.997 |
| | | Mid | 8.777 | 0.003† | 0.042 | 0.838 |
| | | Big | 20.826 | <0.001† | 0.151 | 0.995 |
| | L-Drill | Skill | 16 | <0.001† | 0.094 | 0.980 |
| | | Mid | 11.213 | <0.001† | 0.053 | 0.838 |
| | | Big | 11.485 | <0.001† | 0.092 | 0.919 |

†Significant difference between starters and non-starters; ‡Non-Significant difference (p>0.05 to p<0.10) between starters and non-starters

### B. Fishers LSD Pos-hoc Comparision

| Test | Position | MDiff | SE | Sig. | 95% CI diff | d |
|---|---|---|---|---|---|---|
| 40-yard sprint | Skill | -0.157† | 0.026 | <0.001 | -0.209 to -0.106 | -0.10 |
| | Mid | -0.145† | 0.030 | <0.001 | -0.204 to -0.087 | -0.70 |
| | Big | -0.136† | 0.043 | 0.002 | -0.222 to -0.050 | -0.60 |
| Pro-Agility | Skill | -0.159† | 0.027 | <0.001 | -0.212 to -0.106 | -0.99 |
| | Mid | -0.062† | 0.026 | 0.018 | -0.113 to -0.011 | -0.35 |
| | Big | -0.186† | 0.075 | 0.015 | -0.334 to -0.037 | -0.45 |
| L-Drill | Skill | -0.216† | 0.04 | <0.001 | -0.296 to -0.137 | -0.17 |
| | Mid | -0.133† | 0.039 | 0.001 | -0.209 to -0.057 | -0.49 |
| | Big | -0.14‡ | 0.074 | 0.06 | -0.287 to 0.006 | -0.35 |
| 40-yard sprint | Skill | 43.683† | 9.289 | <0.001 | 25.338 to 62.028 | 0.77 |
| | Mid | 45.821† | 10.620 | <0.001 | 24.884 to 66.758 | 0.62 |
| | Big | 59.463† | 12.814 | <0.001 | 34.091 to 84.834 | 0.87 |
| Pro-Agility | Skill | 23.941† | 5.035 | <0.001 | | 0.78 |
| | Mid | 17.533† | 5.918 | 0.003 | | 0.44 |
| | Big | -38.622† | 8.463 | <0.001 | | 0.87 |
| L-Drill | Skill | 19.093† | 4.723 | <0.001 | 9.764 to 28.422 | 0.67 |
| | Mid | 18.405† | 5.496 | 0.001 | 7.566 to 29.244 | 0.50 |
| | Big | 24.685† | 7.284 | 0.001 | 10.258 to 39.112 | 0.65 |

MDiff represents the starters data minus the non-starters data; †Significant difference between starters and non-starters; ‡Non-Significant difference (p>0.05 to p<0.10) between starters and non-starters

### C. ROC Curve Results

| Test | Position | AUC | Sig. | 95% CI diff |
|---|---|---|---|---|
| 40-yard sprint | Skill | 0.224 | <0.001 | 0.151 to 0.298 |
| | Mid | 0.298 | <0.001 | 0.225 to 0.370 |
| | Big | 0.348 | 0.006 | 0.248 to 0.449 |
| Pro-Agility | Skill | 0.236 | <0.001 | 0.162 to 0.310 |
| | Mid | 0.397 | 0.016 | 0.151 to 0.298 |
| | Big | 0.323 | <0.001 | 0.151 to 0.298 |
| L-Drill | Skill | 0.271 | <0.001 | 0.195 to 0.348 |
| | Mid | 0.367 | 0.002 | 0.151 to 0.298 |
| | Big | 0.37 | 0.017 | 0.266 to 0.473 |
| 40-yard sprint | Skill | 0.725* | <0.001 | 0.645 to 0.804 |
| | Mid | 0.673 | <0.001 | 0.594 to 0.752 |
| | Big | 0.732* | <0.001 | 0.640 to 0.823 |
| Pro-Agility | Skill | 0.835** | <0.001 | 0.762 to 0.908 |
| | Mid | 0.789* | <0.001 | 0.700 to 0.877 |
| | Big | 0.796* | 0.002 | 0.683 to 0.909 |
| L-Drill | Skill | 0.684 | <0.001 | 0.600 to 0.768 |
| | Mid | 0.644 | <0.001 | 0.562 to 0.762 |
| | Big | 0.699 | <0.001 | 0.604 to 0.794 |

*0.7-0.8 is considered acceptable, **0.8-0.9 is considered excellent, and ***more than 0.9 is considered outstanding

- Univariate ANOVA revealed differences in time and momentum between starters and non-starters (See Table 1A and 1B).
- Poor ROC curves for time.
- Significant acceptable-to-excellent ROC curves for momentum in the 40-m and ProA tests across positional groups(See Table 1C).
- Near-acceptable ROC curves for the L-drill across all positions (See Table 1C).
- For 40-m momentum, cutoff values of >690.3 kg·m·s-1 and >881.1 kg·m·s-1 were established for starters for the skill and big positions, respectively.
- For ProA test, a cutoff value of >385.3 kg·m·s-1 was established for the skill position, while the cutoff values of >428.2 kg·m·s-1 and >493.5 kg·m·s-1 were established for starters for the mid and big positions, respectively.

## Methods

- 512 DI Collegiate Football Players
- Momentum was calculated by converting the sprint time into a velocity and then multiplied by the athletes' body mass in kg.
- Position groups were analyzed separately.
- Only the initial results were included in the analysis to eliminate training effect.
- Receiver Operating Characteristic Curves were also performed to ensure false positives were not creating a false difference.

## Statistical Analysis

- Normality check: Shapiro-Wilk Test.
- Univariate ANOVA was used to determine the differences
- Effect sizes: Cohen's d.
- ROC Curves: to delineate between those who made the NFL.
  - An area under the curve (AUC): <0.5 = poor, 0.7-0.8 = acceptable, 0.8-0.9 = excellent, >0.9 = outstanding



| MASS | VELOCITY | | MOMENTUM |
|---|---|---|---|
| 90 kg | 8.5 m/s | = | 765 kg/m/s |
| 100 kg | 8.5 m/s | = | 850 kg/m/s |

## Conclusions and Practical Application

These findings suggest that momentum tracking across position groups should be more heavily relied on than simply time to completion of the specific test when deciding starter vs. non-starter status. Coaches can make decisions regarding starting players based on these performance cutoff values for momentum.