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The National Football League Combine: A Reliable Predictor of Draft Status?

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ABSTRACT

The performance of 326 collegiate football players attending the 2000 National Football League combine was studied to determine whether draft status could be predicted from performance measurements. The combine measured height and weight along with 9 performance tests: 225-lb bench press test, 10-yd dash, 20-yd dash, 40-yd dash, 20-yd proagility shuttle, 60-yd shuttle, 3-cone drill, broad jump, and vertical jump. Prediction equations were generated for 7 position categories with varying degrees of accuracy—running backs (RBs), $r^2 = 1.00$; wide receivers (WRs), $r^2 = 1.00$; offensive linemen, $r^2 = 0.70$; defensive linemen, $r^2 = 0.59$; defensive backs (DBs), $r^2 = 1.00$; linebackers, $r^2 = 0.22$; and quarterbacks, $r^2 = 0.84$. The successes of the prediction equations are related to the ability of the individual tests to assess the necessary skills for each position. This study concludes that the combine can be used to accurately predict draft status of RBs, WRs, and DBs. The equations can also be used as a good to fair estimate for other positions.

Key Words: performance, testing, skill

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Introduction

Each year the National Football League (NFL) has the opportunity to choose new rookie athletes from a pool of collegiate football players. Before the rookie draft, the NFL holds a testing camp referred to as the combine. The combine is a forum for individual athletes to showcase their talents in the hope of being drafted to a professional football team. At the combine, prospective NFL football players are evaluated on their athletic ability, health, and mental acuity. The combine also affords coaches the opportunity to collect information that may help determine which players are of interest to them. Coaches can personally meet and evaluate the player's physical stature, personality, and athletic performance measurements without National Collegiate Athletic Association restrictions.

The intent of this investigation was to determine whether a relationship exists between an athlete's performance results taken at the NFL combine and his or her level of draft success or nondraft success. The following performance measurements are taken by the athletes at the combine: 225-lb bench press test, 40-yd dash with 10- and 20-yd split times, 20-yd shuttle (proagility run test), 60-yd shuttle, 3-cone drill, vertical jump, and broad jump. These individual tests have been validated as measurements of athletic ability (2, 3, 5–7, 9–11, 13, 14, 16, 17, 22, 23). The purpose of the combine performance tests is to provide a good indication of an athlete's physical ability, although it may not translate as a measurement of talent on the football field (19).

If a relationship exists between combine performance and draft status, specialized training for the specific combine testing criteria could benefit individual athletes financially. In 1999 the average signing bonus and salary for a first-round–draft choice was $4,490,700 and $1,341,690, respectively. The 1999 average signing bonus and salary for a seventh-round–draft choice were $23,830 and $255,240, respectively (NFL Players Association (NFLPA) representative, personal communication, November 2000). A football player's economic benefit is greatly increased by advancing between rounds or even within the same round of the draft. An athlete drafted in the fourth round vs. an athlete drafted in the fifth round, possibly as a result of combine performance results, will receive on average $169,790 more at contract negotiation (Table 1).

Performance measures could also be used as a means of predicting future athletic success in football (1, 18). Application of performance measurements could be further used as a method of screening potential football athletes at all levels. However, if performance measurement results in the combine testing do not relate to draft status, then perhaps performance on the playing field would be a better indicator of draft success than would performance measurements.

The authors hypothesize that draft status of NFL prospects has little to no relationship with many of the

Table 1. 1999 Average salary and signing bonus per draft round.

Round	Salary	Signing bonus
1	$1,341,690	$4,490,700
2	$584,900	$952,930
3	$379,750	$391,980
4	$325,460	$228,170
5	$285,810	$98,030
6	$267,250	$49,940
7	$225,240	$23,830

Table 2. Seven position categories.

Quarterback
Wide receivers
Running backs
Offensive line
Offensive tackle
Offensive center
Offensive guard
Tight end
Defensive line
Defensive end
Defensive tackle
Nose tackle
Defensive backs
Defensive corner
Free safety
Strong safety
Linebackers (LB)
Inside LB
Outside LB
Full backs

performance measures taken at the combine. This hypothesis is based on the inconsistency of the findings of previous studies that assessed performance characteristics in collegiate-level football (8, 12, 15, 18, 20, 21, 24). Furthermore, studies to date have not assessed physical ability characteristics of professional football players as a determinate of field success, which, for the purpose of this study, could serve as a predictor of draft status.

Methods

Subjects

Three hundred and twenty-six college football players who entered the 2000 NFL draft participated in the combine testing camp. The 326 football players were categorized at the combine according to position: quarterbacks (QBs, $n = 17$), punters or kickers (PKs, $n = 10$), inside linebackers (ILBs, $n = 11$), outside linebackers (OLBs, $n = 26$), defensive tackles (DTs, $n = 24$), defensive ends (DEs, $n = 22$), defensive corners (DCs, $n = 34$), free safeties (FSs, $n = 14$), strong safeties (SSs, $n = 11$), fullbacks (FBs, $n = 6$), running backs (RBs, $n = 37$), wide receivers (WRs, $n = 45$), tight ends (TEs, $n = 16$), offensive guards (OGs, $n = 26$), offensive tackles (OTs, $n = 18$), offensive centers (OCs, $n = 4$), and nose tackle (NT, $n = 1$). For the purpose of this study, the above positions were combined into 7 position categories based on similarities of position needs (see Table 2). The average height among all players was 186.4 cm, and the average weight was 109.1 kg.

Participation in the 2000 NFL combine testing camp is voluntary, but only those invited may attend. Football players are interested in attending the combine testing camp because it gives the athletes the opportunity to impress coaches and scouts. Eligible athletes were not mandated but were encouraged to participate in all 9 of the performance measurements. Quarterbacks, PKs, and WRs did not perform the 225-lb bench press test. Quarterbacks, PKs, DTs, DEs, NTs, OCs, OGs, and OTs did not perform the 60-yd shuttle.

Not all football players present at the combine performed all 9 of the performance measurements. The data from injured players who did not fully participate and from players who decided on their own or were advised by their agents not to perform certain performance measurements were not used in the statistical analyses of this study. Because of the large number of participants and the even distribution of athletes who did not test among all groups, data are not likely to be adversely affected.

Data Collection

The NFL combine testing camp was held in Indianapolis, IN, at the RCA dome in late February 2000. This study is a retrospective design and used the results obtained by the combine from performance tests. Use of the data through an institutional review board is considered a nonissue because the combine results can be found in various public access domains, and individual participant names will not be revealed. The data were analyzed using the results from the following combine tests.

225-lb Bench Press to Fatigue Test

The 225-lb bench press to fatigue test is the only test to measure upper-body muscular strength in the testing battery of the combine. Athletes were instructed to complete as many bench press repetitions with 225 lb as possible. A countable repetition was defined as lowering the weight just touching the chest, followed by a brief pause and then an upward push to return the weight to the starting position with arms fully extended.

40-Yd Dash With 10- and 20-Yd Split Times

The 10-, 20-, and 40-yd dash tests anaerobic power, acceleration, and speed (1). Electronic timing devices were placed at the starting line and the 10-, 20-, and 40-yd lines. Time was recorded at all 3 distances to one-hundredth of a second. When the athlete was in proper position, he sprinted as fast as he could from the starting line through a string placed at the 40-yd–dash marker that signified the completion of the sprint.

20-Yd Shuttle Proagility Run Test

The 20-yd shuttle, also known as the proagility run test, measures the anaerobic power, the ability to increase and decrease speed rapidly, and the ability to change direction quickly. To perform the 20-yd shuttle, an athlete straddled the 15-yd line, ran to his right, and touched the 20-yd line. Then, he quickly changed direction, sprinted past the 15-yd line, and touched the 10-yd line. Again he quickly changed direction and finished by sprinting through the 15-yd line. Athletes performed the test twice, once in each direction. The average time was recorded for each direction.

60-Yd Shuttle

The 60-yd shuttle is a measure of speed, flexibility, body control, and a small level of endurance (13). The shuttle is a basic out-and-back running test from the goal line to the 5-, 10-, and 15-yd lines. Time was recorded from the athlete's initial movement until completion of the shuttle to the nearest one-hundredth of a second.

3-Cone Drill

The 3-cone drill is a measurement of agility, change in direction, and power (13). To perform the 3-cone drill, 3 cones were positioned in an upside-down ''L'' formation. The athlete started at cone 1 from a 3-point stance behind the starting line. On his own volition, the athlete sprinted as fast as possible and touched cone 2, which was 5 yd directly in front of him, and immediately returned to cone 1. Without stopping, the athlete changed directions, cornered cone 2, and sprinted directly to cone 3, which was 5 yd lateral to cone 2, on the athlete's right-hand side. The athlete circled cone 3 to his left, then returned to the first cone by cornering cone 2 and sprinting at full speed past cone 1, which marked the finish line. Time was recorded to the nearest one-hundredth of a second.

Vertical Jump

The vertical jump is a measure of leg strength and anaerobic power (4). The Vertec was used to assess the vertical jump. The athlete positioned himself directly underneath the vanes of the Vertec, allowing him to touch the vanes by jumping straight up without any lateral adjustments. The athlete lowered his center of gravity in a counter movement and explosively jumped straight up in the air off of both feet. The goal of the athlete was to hit the highest vane possible with 1 hand. The athlete's vertical jump was measured by subtracting the height of the athlete's standing reach from the height of the highest vane hit.

Standing Broad Jump

The standing broad jump was used as a measure of leg strength and power (5). The athletes were instructed to assume a position with their toes behind the taped line marked ''zero inches.'' When an athlete was set, he jumped horizontally, taking off from both feet on his own command. The distance jumped was recorded from the start line to the point of heel contact or the closest body part measured to the nearest inch.

Statistical Analyses

To determine whether the 9 performance measures affected draft order and the relative importance of each test to draft position, multiple linear regressions were generated using SPSS 10.0. Regression equations were generated using a step-wise regression procedure. Separate analyses were conducted for the 7 subgroups: QBs, offensive line (OL), defensive line (DL), WRs, RBs, defensive backs (DBs), and linebackers (LBs). Pearson's r correlation matrix and r^2 matrix were also generated using SPSS 10.0 to determine the amount of variance in common between each variable for each subgroup.

A 2 by 11 analysis of variance with repeated measures was performed with the 9 performance measures along with height and weight, and draft rounds 1–3 and 4–7. The analysis of variance was used to see whether a difference existed between different rounds and scores in the performance tests. Rounds 1–3 and 4–7 were grouped together on the basis of a $218,100 difference in first-year salary and signing bonus between rounds 3 and 4 (NFLPA, 2000). Each of the 9 performance measures was converted into standard scores. To minimize type I errors, an alpha level of 0.05 was used for all statistical tests.

Results

The correlation matrix was first examined to determine interrelationships among the performance measurements tested using Pearson's correlation of coefficients. A high relationship (>0.95) was found between the 10-, 20-, and 40-yd sprints. The sprinting measurements also were highly correlated between the broad jump (0.86), the vertical jump (0.81), the 20-yd shuttle (0.86), and the players' weight (0.85). A high relationship was also noted between the broad jump and the vertical jump (0.83).

Regression equations were then derived for the 7 divided positions, QB, OL, DL, WR, RB, DB, and LB, to determine in which round an athlete would most likely be drafted into based on their performance mea-

Table 3. Regression equations for the 7 position categories.*

Position	Equation†
QB	1.28(HT) − 1.11(WT) + 1.53(10Y) − 4.09(40Y) − 1.89(BJ) + 0.82(3C)
OL	−0.53(HT) − 0.34(REP) − 3.08(20Y) + 2.87(40Y) − 0.40(VJ)
DL	0.77(HT) + 1.51(WT) − 0.99(REP) + 1.37(10Y) − 2.25(20Y) + 0.72(40Y) − 0.15(VJ) + 1.40(BJ) − 1.42(20S) + 1.45(3C)
WR	−1.48(HT) + 0.24(WT) + 0.92(10Y) + 0.52(40Y) − 0.13(VJ) + 0.67(BJ) + 0.80(20S) − 0.41(3C)
RB	0.45(HT) − 2.80(WT) + 0.66(10Y) + 2.77(40Y) + 2.06(VJ) + 1.38(BJ) + 1.09(3C)
DB	1.67(HT) − 1.71(WT) + 4.18(REP) − 0.81(10Y) + 5.46(20Y) − 4.3(40Y) + 0.60(VJ) − 0.93(BJ) + 2.27(20S) − 0.96(60S) + 3.53(3C)
LB	−0.26(WT) − 0.02(REP) + 0.33(10Y) − 0.60(20Y) + 0.48(40Y) + 0.80(VJ) − 0.36(BJ) + 0.02(3C)

* QB = quarterback; HT = height; WT = weight; 10Y = 10-yd dash; 40Y = 40-yd dash; BJ = broad jump; 3C = three-cone drill; OL = offensive line; REP = bench press; 20Y = 20-yd dash; DL = defensive line; VJ = vertical jump; 20S = 20-yd shuttle; WR = wide receivers; RB = running backs; DB = defensive back; 60S = 60-yd shuttle; LB = linebackers.
† Equations use standardized data.

surements. The data used to form the regression equations came from all drafted athletes in their respected positions. The investigators only used the drafted players for analysis to ensure that regression equations were formulated to reflect only the top athletically gifted players. The degree of success in generating regression equations varied by position—QB (r^2 = 0.841), OL (r^2 = 0.698), DL (r^2 = 0.592), WR (r^2 = 1.0), RB (r^2 = 1.0), DB (r^2 = 1.0), and LB (r^2 = 0.223). Refer to Table 3 for the complete regression equations in standardized form.

The final statistical analysis was a 2 (rounds 1–2 and 6–7) by 11 (9 performance measurements plus height and weight) repeated measures analysis of variance. The analysis was run to determine whether a significant difference existed between the performance measurements of the players drafted in the first 2 rounds and the performance measurements of the players drafted in the last 2 rounds. Mauchly's test of sphericity was conducted on the data and was found to be significant using the Greenhouse-Geisser tests of within subject's effects. A cubic relationship was found among the tests. Significant differences of $p < 0.05$ existed between first- and second- vs. sixth- and seventh-round–drafted athletes in the broad jump, vertical jump, and 3-cone drill.

Discussion

Through analysis of the performance-testing battery of the combine, several of the performance measurements conducted at the combine were highly correlated with each other. The high interrelation among tests indicates that many of the tests assess the same abilities. The high correlation found in the 10-, 20-, and 40-yd dashes (>0.95) indicates that only 1 of the 3 measures may be necessary to access the same skill. The speed measurements also were highly correlated with other power assessments such as the broad jump and the vertical jump. A player who tests well in the 10-yd dash could also be expected to perform well in the 20-yd dash, 40-yd dash, 20-yd shuttle, vertical jump, and broad jump. Thus 67% of the performance-testing battery of the combine assessed or reassessed the same performance capabilities of speed and explosive power.

Performance test with a low correlation in comparison with other tests shows that the skill being measured is unique. The 225-lb bench press test, the 3-cone drill, and the 60-yd shuttle are not as highly correlated with the other tests in the testing battery of the combine. This signifies that these tests measure different components of performance; however, it does not signify that these tests are valuable in determining whether an athlete could be successful playing in the next level.

Regression statistics were computed to determine which measurements were most closely related to the draft round for each position. The computed regression equations were variably successful in determining a player's draft round depending on position. The specific duties and requirements of the athletes in their positions can, to some extent, explain the success or nonsuccess of the accuracy of the regression equations. The investigators' rationale is also given as a justification for tests with the most predictive abilities for each position subgroup.

Running backs, WRs, and DBs had a success rate of r^2 = 1.0 in determining the draft round. The high success in predicting draft round for these players may be because these positions are the most dependent on speed and agility, which most tests in the combine assess. The most significant predictors for success in these positions were 3-cone drill, height, weight, 10-yd dash, and vertical jump.

The regression equations also were able to predict the draft round of prospective NFL QBs with a high degree of success: r^2 = 0.84. The largest predictor for

Table 4. Descriptive characteristics of rounds 1 and 2 vs. rounds 6 and 7 subjects.

Characteristics	Rounds 1 and 2 Mean ± *SD*	Rounds 6 and 7 Mean ± *SD*
Height	74.15 ± 2.57	73.8 ± 2.35
Weight	247.93 ± 49.86	245.56 ± 48.58
Bench press	21.83 ± 6.75	20.59 ± 6.95
10-yd dash	1.68 ± 0.11	1.71 ± 0.11
20-yd dash	2.79 ± 0.18	2.85 ± 0.19
40-yd dash	4.81 ± 0.31	4.93 ± 0.34
Vertical jump	33.31 ± 3.26	31.23 ± 4.15
Broad jump	113.39 ± 9.18	109.18 ± 9.84
20 Shuttle	4.38 ± 0.29	4.45 ± 0.29
60 Shuttle	11.39 ± 0.26	11.53 ± 0.22
3-Cone drill	7.23 ± 0.41	7.46 ± 0.46

QBs was the 3-cone drill, a test of speed and agility. However, the performance measurement battery of the combine does not assess several important qualities of a great QB. These skills include throwing distance, arm accuracy, and the ability to read the defense and make quick passing decisions.

The regression equations were less accurate in predicting the draft rounds of the OL and DL athletes, $r^2 = 0.70$ and $r^2 = 0.59$, respectively. The position requirements of the OL and DL players are less speed specific. Most of the testing batteries of the combine measure speed-related abilities. Tests that were determined to be the best predictors for the success of the OL and DL players are height, weight, bench press, broad jump, and 3-cone drill.

The regression equation had little success, $r^2 = 0.22$, in predicting the success of LBs. The testing battery does not offer a performance measurement that allows significant transfer to the LB position. The absence of a sound means of assessment makes it difficult to determine the level draft success of LBs purely from the results of the performance measurement tests. Quickness to react as well as the ability to read the offense characterizes the position of an LB, and these skills are not assessed through the combine performance measurements. The most significant measurements found for the LB position were weight followed by the 10- and 40-yd dashes.

The combine performance measurements only measure physical capabilities. The means of the sixth- and seventh-round–drafted athletes provide a basic description of the minimal physical requirements for playing in the NFL (see Table 4). Although there are many other factors, the combine does not measure those that are important to a football player's level of success. Factors such as an athlete's determination, toughness, and ability to work as part of a team need to be assessed to determine whether an athlete will make a great football player.

Significant differences were found by analyzing the performance measurement results between the first- and second-round athletes as compared with the sixth- and seventh-round athletes of all positions. The first- and second-round–drafted athletes were collectively taller, heavier, stronger, and faster in all 3 linear running distances as well as in the 3 agility shuttles and could jump both higher and farther when compared with the sixth- and seventh-round–draft picks. These results could be expected after examining the regression data and realizing the extent to which the performance measurement tests were able to determine draft success in most positions.

Practical Applications

The results of this study can be directly applied to football players of many levels. First and foremost, coaches training football players entering the NFL draft can identify, by using the regression equations, which tests most affect the athlete's success and which tests have little effect on draft status. For example, the vertical jump was the most important test to determine draft success in the RB position, whereas the 225-lb bench press test had little to no effect. By familiarizing the athlete with the vertical jump testing procedures and apparatus, improving jumping technique, and directing training workouts toward increasing jump height, an athlete may test better at the combine and thereby increase his or her draft prospects as well as the amount of salary and signing bonus.

Study findings could also be used when determining which position an athlete is most suited for and in which position an athlete will likely be most successful. Each position weighs the performance measurements differently to determine the individual needs of the position. By assessing an athlete's height, weight, and performance measurements, a coach could use the regression equations to scientifically predict a position for the athlete. The success of predicting the football player's correct position depends on the accuracy of the regression equations, and better results will be obtained in predicting WRs, RBs, and DBs as compared with LBs.

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