The Star-Ledger

NFL Scouting Combine

ILLUSTRATION BY ANDRE MALOK/THE STAR-LEDGER

Scoring with science

Prospects go high-tech for their best shot at the pros

BY JENNY VRENTAS
STAR-LEDGER STAFF

The annual NFL Scouting Combine — which began yesterday and runs through Tuesday in Indianapolis — has almost a scientific precision to it.

The hundreds of invited NFL Draft hopefuls are numbered, prodded, measured and clocked as scouts and team personnel expand their data files on each. The prospects themselves have spent weeks training at Combine preparation facilities all over the country, priming their bodies for the exact parameters on which they'll be evaluated.

"One misstep could cost these guys millions of dollars, and they know that," said Brian Martin of New Jersey's TEST Sports Clubs, where 32 NFL hopefuls have been training this winter.

But what about the actual science behind the Combine drills and preparation? How do prospects go faster, get stronger and jump higher? How do their measurable abilities translate to the football field?

Physics can explain how the speed at which a quarterback throws the ball affects how far and fast he can deliver it to a receiver. Performance in the vertical jump and the 40-yard dash can be maximized using the principles of physics and kinesiology.

Combine performance, of course, hasn't always proved to be a foolproof indicator of success in the professional ranks. But for prospects looking to get any edge they can, this weekend is one critical hurdle leading up to the NFL Draft in April.

Without preparation, "a player would definitely be at a disadvantage relative to everybody else there," said agent Joe Linta, who represents Ravens quarterback Joe Flacco, "though in the end result of draft status, it's 5 to 10 percent at the most."

INSIDE: An in-depth look at three important Combine diagnostics: quarterback passing drills, the vertical jump and the 40-yard dash. **Page 38**

MAXIMIZING MOTION

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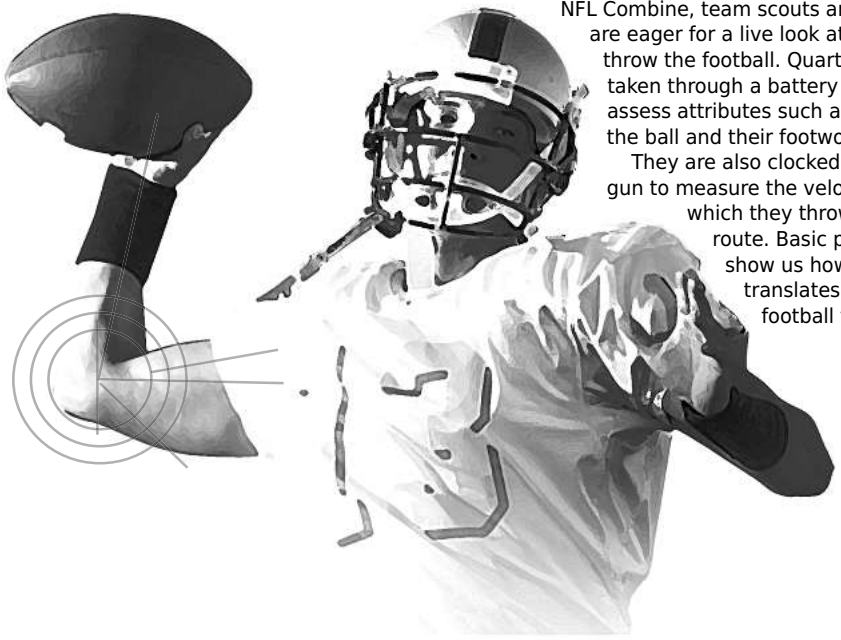


PASSING DRILLS

When quarterbacks do their position drills at the NFL Combine, team scouts and personnel are eager for a live look at how they throw the football. Quarterbacks are taken through a battery of drills that assess attributes such as their grip on the ball and their footwork.

They are also clocked with a radar gun to measure the velocity with which they throw on an out route. Basic physics can show us how velocity translates to the football field, using the 20-yard out as a benchmark for a quarterback's pro-readiness.

At the 2008 NFL Combine, Ravens first-round pick and TEST client Joe Flacco — who had a meteoric rise up the draft boards last spring — set the mark for throwing velocity at 58 mph.

"He separated himself from just about everybody by the velocity of the ball," said Flacco's agent, Joe Linta, "though it's really one factor in the whole process."

The flight of a football can be calculated using equations for projectile motion, if air drag is neglected.

THE EQUATIONS

1 $R = \frac{V_0^2}{g} \sin 2\theta_0$ **2** $t = \frac{R}{V_0 \cos\theta_0}$

EQUATION KEY

- R = Horizontal distance the football travels
- V_0 = Initial velocity of football when it leaves passer's arm
- Θ_0 = Angle above horizontal in the direction football is thrown
- g = Magnitude of gravitational acceleration (32.17 ft/sec^2)
- t= Time it takes for football to travel from passer to receiver

How fast the QB throws affects how far he can throw

From **equation 1**, the angle that achieves the maximum range is 45°, so the sine term is equal to 1.

If QB1 throws the ball at 60 mph, he can throw it 80.2 yards. If QB2 throws at 50 mph, he can throw the ball 55.7 yards. (Illustration below)

CONCLUSION: If the game's on the line and you need your QB to throw a Hail Mary, QB1's 10 mph better speed means 25 extra yards.

A QB's arm strength also affects how fast his 20-yard pattern arrives

Use **equation 1** to calculate the angle the QB has to throw the pass and **equation 2** to calculate the time it takes to go 20 yards.

QB1 throws the ball at an angle of 7.22° and it takes 0.687 seconds to travel 20 yards.

QB2 throws the ball at an angle of 10.52° and it takes 0.832 seconds to travel 20 yards.

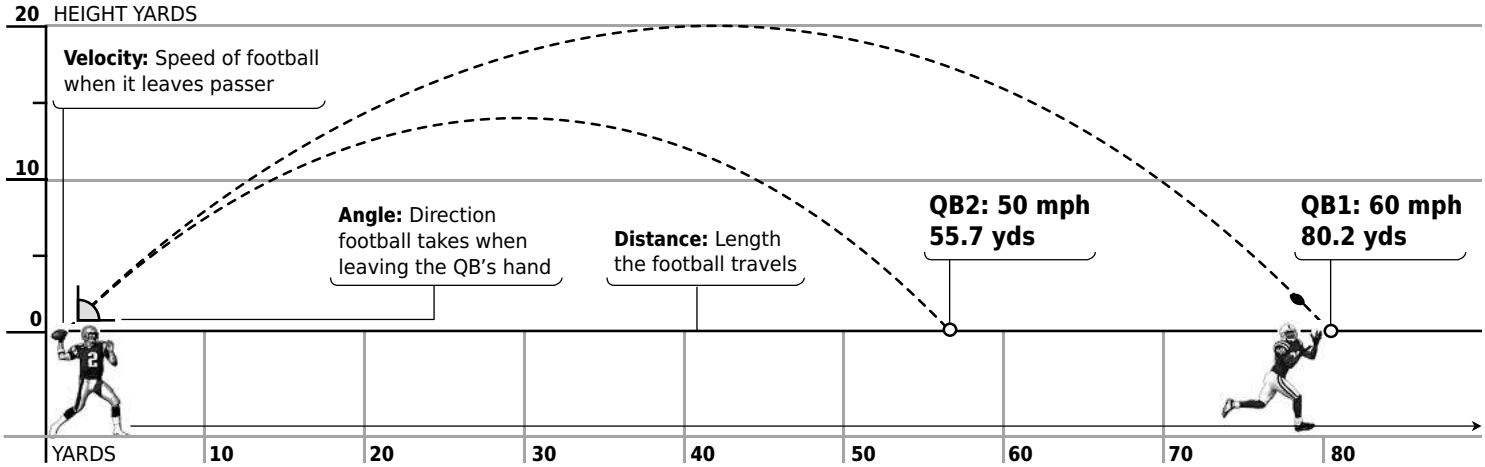
CONCLUSION: When QB1's receiver catches his 20-yard pass, QB2's pass has traveled only 16.5 yards.

How fast a deep pass (here 50 yards) gets to the receiver depends on the angle at which it is thrown

Take QB1 (60mph) — if he throws a flat pass (θ_0=19.3°), it takes 1.8 seconds.

If he throws a higher arc pass (θ_0=70.7°) it takes 5.2 seconds.

CONCLUSION: The QB can either throw a low pass on a rope or loft a high-arcing floater.



HOW HIGH CAN HE JUMP?

FRANK H. CONLON/THE STAR-LEDGER

Michigan defensive back Morgan Trent, right, uses the Power Plate machine alongside TEST founder Brian Martin during a morning workout last week.

VERTICAL JUMP

The vertical jump — in which players stand flat-footed in front of a pole, jump and try to swat as many plastic flags as they can — assesses a player's range and explosiveness. It's also one of the reasons the TEST training facility brings its Power Plate machines to Indianapolis, because the effects of the machine's vibrations, which last about an hour, can improve jumping ability.

HOW DOES THE POWER PLATE WORK?

The principle behind the Power Plate machines is Newton's Second Law of Motion: *Force equals mass multiplied by acceleration.*

Most forms of training use mass — such as bars, dumbbells or weight stacks — to increase the force of gravity on a particular set of muscles. The force on those muscles is equivalent to the mass of the weight being used multiplied by the acceleration due to gravity on Earth (g = Magnitude of gravitational acceleration 32.17 ft/sec^2).

The Power Plate, however, uses a vibrating platform to increase force via acceleration. The platform generates accelerations between 1.83 g to 6.36 g, thus multiplying the force on the body anywhere from 1.83 to 6.36 times. If Power Plate users also bring weights onto the machine, the force on their muscles will multiply because of both mass and acceleration.

Because of the way Power Plates work, they serve numerous purposes, including:

■ Rehabbing injuries, because the machines strengthen muscles and joints without applying stress the way weight training would.

■ Retraining movement patterns, because the rapid vibrations on the Power Plate (25 to 50 times per second) stimulate sensory receptors and result in a number of muscle contractions far exceeding what could be done voluntarily.

HOW DOES IT AFFECT THE VERTICAL JUMP?

Several scientific studies have found that standing on a Power Plate for a short period of time can lead to an increase in vertical jump height. A simple trial done at TEST saw a 1- to 2.5-inch increase in vertical jump height directly after players used the Power Plate for a minute.

At the tightly controlled NFL Combine, there is no way for players to use the Power Plate right before their vertical jump. TEST owners Brian Martin and Kevin Dunn still try to have their clients use the Power Plate right before they head into the RCA Dome for testing — though the drills can sometimes take two hours, long past the time frame for any competitive edge.

HOW FAST CAN HE RUN?

COURTESY OF TEST

Dartfish freeze frames of South Carolina wide receiver Kenny McKinley running a 40-yard dash trial at TEST last week.

40-YARD DASH

In the Combine's marquee diagnostic, tenths of a second separate elite speed from average. At training facilities such as TEST, the staff not only works to maximize its clients' explosiveness, it also uses video software called Dartfish to intricately analyze players' movements in trial runs — and shave off those critical tenths.

HOW DOES IT WORK?

The analysis of the prospects' body movements begins with a Functional Movement Screen. The FMS is a grading system for seven movement patterns to identify weaknesses, limitations or asymmetries in the body that can hinder peak performance.

For instance, if a player has tight hip flexors, he won't have full use of the antagonist muscle, the gluteus maximus in the buttocks. As a result, he may try to extend his hip using his hamstring — which can lead to muscle strains. Limitations like these need to be fixed through correctional exercises, so they don't become a problem in explosive activities such as the 40-yard dash.

The week before the Combine, TEST's prospects ran a practice 40, which Martin and Dunn broke down in slow-motion with Dartfish.

They look for three things in the three-point stance at the starting line: 1) if the weight of the raised arm is "loaded" in the shoulder, so it can burst forward: 2) if the buttocks are raised: and 3) if the player is holding his breath. All three help contribute to an explosive start.

As the players break into their sprint, staff members also watch for them to keep their arms tight to the body to reduce resistance or side-to-side movement and drive their knees upward to a 90-degree angle.

Dartfish's slow-motion speed allows Martin and Dunn to see if the players have properly corrected the weaknesses detected in the FMS. The software can also be used to create successive imprints of the player's body as he runs and can trace one body part through the course of the sprint.

WHAT ARE THE RESULTS?

Dropping two-tenths in a month of training is a typical result. Perhaps most impressive is Utah DB Brice McCain, who is training for his school's Pro Day. When he arrived at TEST four weeks ago, he ran in the 4.3 to 4.4 range. Last week he was clocked at an extraordinary 4.19 on three watches.

FRANK H. CONLON/THE STAR-LEDGER

LOCAL FLAVOR

Eleven players at the NFL Combine have ties to New Jersey:

POS	PLAYER	COLLEGE	HIGH SCHOOL
WR	Kenny Britt	Rutgers	Bayonne
RB	Donald Brown	Connecticut	Red Bank Catholic
LB	Brian Cushing	Southern Cal	Bergen Catholic
DB	Courtney Greene	Rutgers	New Rochelle (N.Y.)
RB	Shonn Greene	Iowa	Winslow Township
DB	Malcolm Jenkins	Ohio State	Piscataway
OT	Eugene Monroe	Virginia	Plainfield
RB	Knowshon Moreno	Georgia	Middletown South
DT	B.J. Raji	Boston College	Westwood
WR	Tiquan Underwood	Rutgers	Notre Dame
QB	Drew Willy	Buffalo	Randolph