SAFETY ENTROPY:

A Measure of Safety Predictability

aws | NFL

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"If I could know with 100% certainty what the safeties would do, my life would be twice as easy."

– Josh Rosen

GOAL:

- Estimate the probability that the safeties will leave the **M**iddle **O**f the **F**ield **O**pen—*MOFO probability*—from pre-snap tracking data.
- If one safety covers the middle, then the **M**iddle **O**f the **F**ield is **C**losed—*MOFC*.

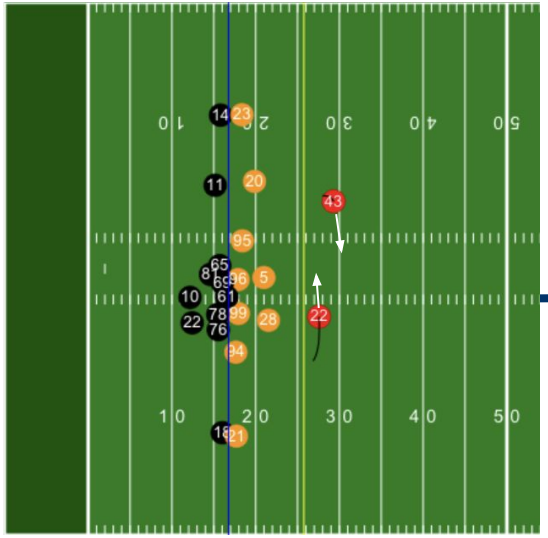
- MOFO examples: Cover 0, 2-Man, Cover 2, Cover 4, Cover 6
- MOFC examples: Cover 1, Cover 3

Modeling process

Tracking data: safeties' pre-snap locations & directional velocities

Model fit from all early-down dropbacks, 5+ yards to go

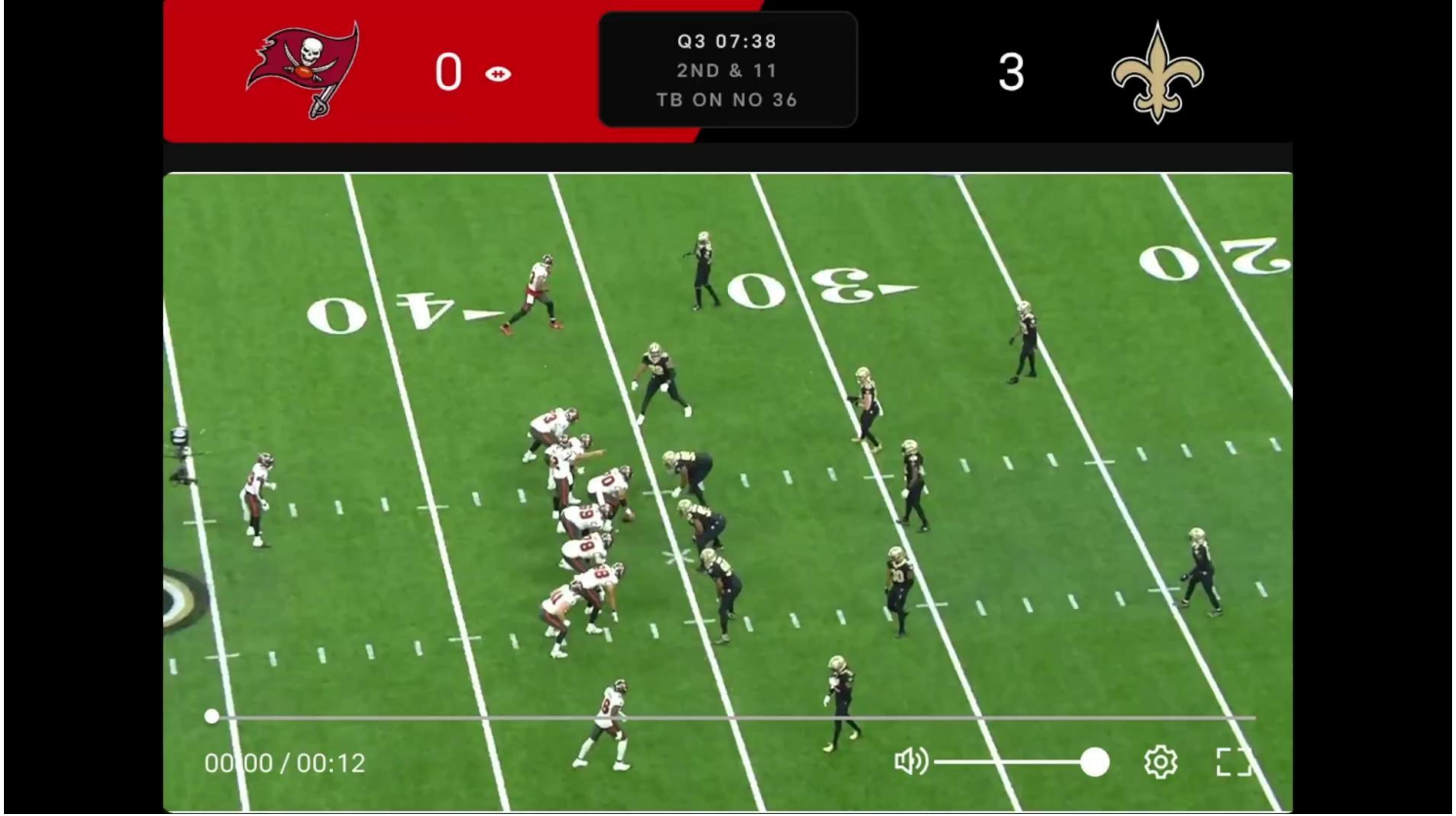
Play-level MOFO probability



MOFO probability model

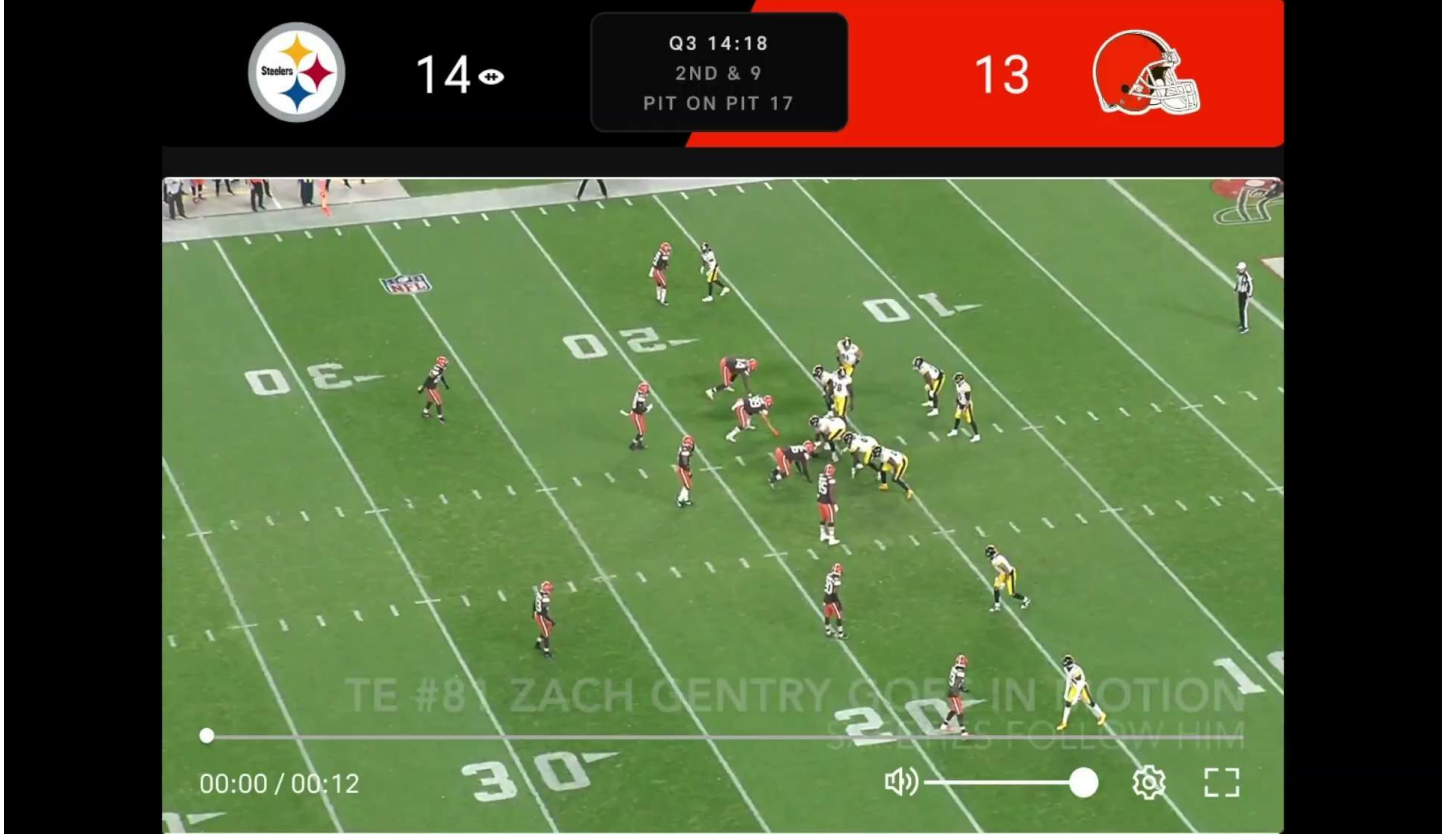
1%

Our model gives the offense **≈27 more "free" plays per season** than baseline models.



- Estimated MOFO probability: 94%
- Actual coverage: Tampa 2 (Open)

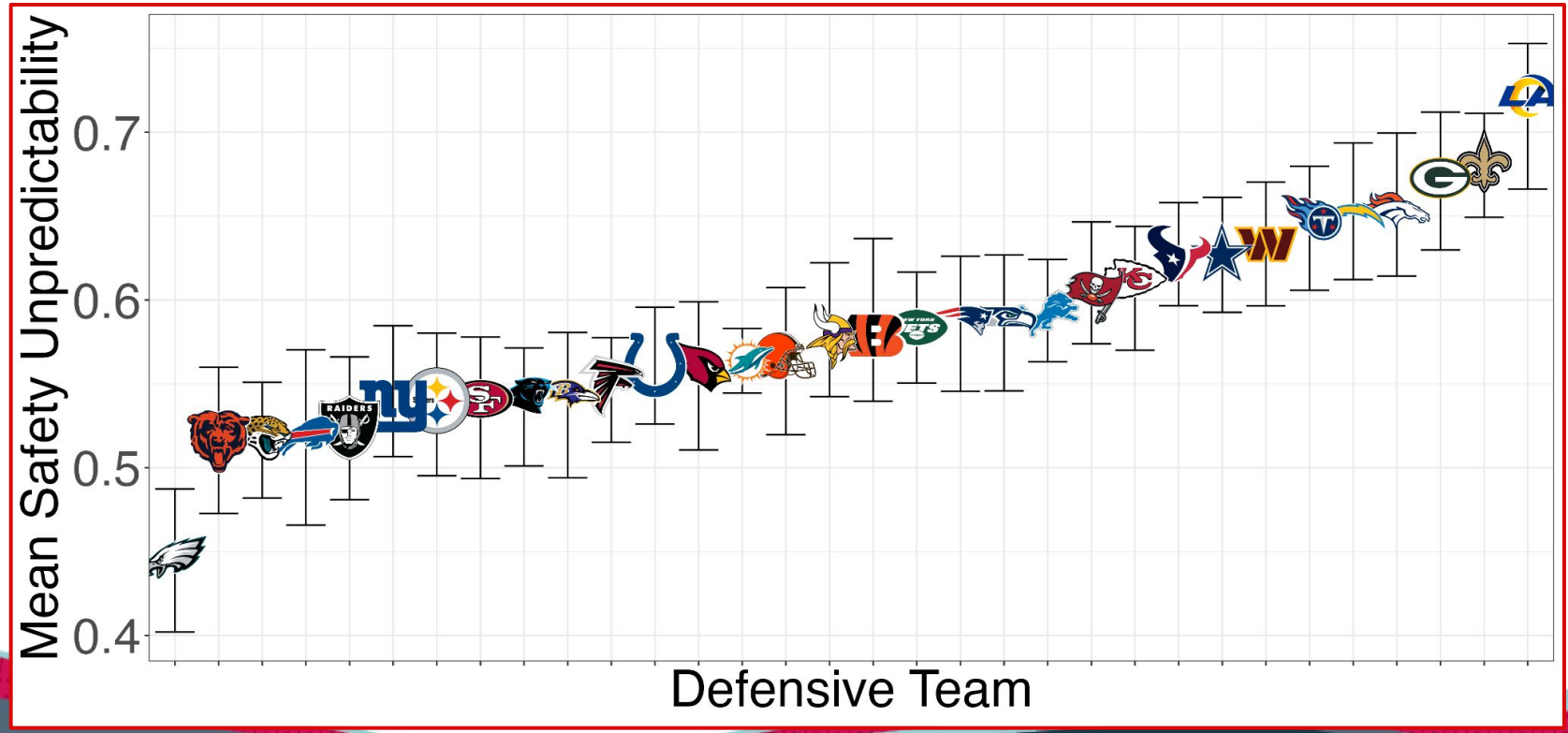
- No following motion TE
- Safeties share similar vertical location & velocities



- Estimated MOFO probability: 1%
- Actual coverage: Cover 1 (Closed)

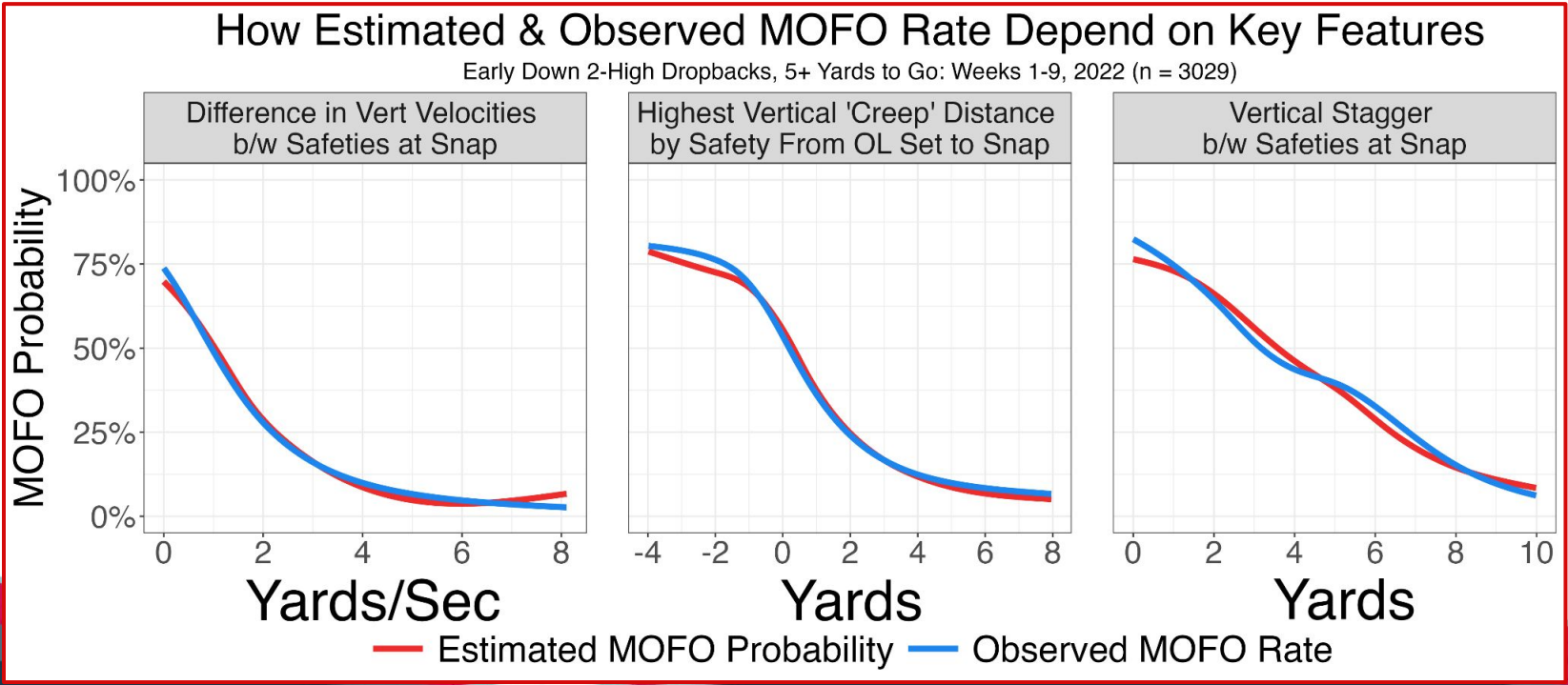
- Defense follows motion TE
- Safeties are vertically staggered
- One safety backpedals, one walks up

Ranking teams by algorithmic safety unpredictability



Understanding MOFO probability estimates from 2-high shells

Note: 1 yard/sec ≈ 2 MPH (slow walk)



What are safeties' biggest coverage tells?

Notable Coverage Tells From Defensive 2-High Shells

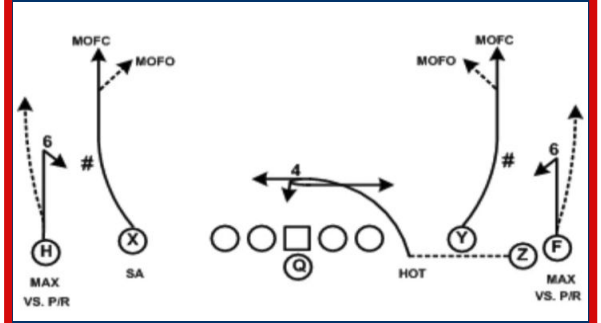
Early Down Dropbacks, 5+ Yards to Go: Weeks 1-9, 2022

Variable	Observed MOFC Rate	Predicted MOFC Rate	Frequency
One safety crept 4+ yards up vertically	**92.4%**	**92.5%**	**10.0%**
Safeties have vertical stagger of 7+ yards at snap	**88.9%**	**89.6%**	**18.3%**
Safeties' diff in vertical velocities at snap is 3+ yards/sec	**88.8%**	**89.1%**	**7.0%**
Base Rate among all 2-high plays (early downs, 5+ yds to go)	49.8%	50.2%	100.0%

Vertical velocity: toward LOS is positive, backpedal is negative
Creep distance: difference b/w safety's position at snap vs. at OL set

Safety unpredictability:

Predict whether defense will play MOFO or MOFC.



Rank teams by how unpredictable their safeties are.

Diagnose specific tells that signal the coverage.