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VAA: The Strongest Predictor of Fastball Success

Jackson Hicks · 2025 MLB Statcast Data · n = 357 pitchers (200+ four-seamers)

For the longest time, four-seam fastballs were evaluated based on their velocity. Then, as technology improved, they started getting evaluated on their shape, particularly their “carry,” or induced vertical break (IVB). But I wanted to know what actually is the best predictor of fastball success, so I dove into the data. I pulled every pitcher who threw at least 200 four-seamers in 2025 — a total of 357 — and checked which traits actually predicted whiff rate and contact quality.

IVB barely moved the needle. Velocity and spin rate had a real but modest relationship. The trait that mattered more than all three combined: vertical approach angle, or VAA — essentially how flat or steep the ball crosses the plate. VAA is mostly a function of release point and location — fastballs from a lower release point and thrown higher in the zone will have flatter VAAs.

Methodology

Pitch-level Statcast data for all four-seam fastballs thrown during the 2025 MLB season, aggregated to the pitcher-season level. Sample restricted to pitchers with 200+ four-seamers thrown on the season (n = 357), to keep rate-stat outcomes stable while still measuring trait variables precisely.

Outcome variables:

- Whiff% — swinging strikes divided by total swings.
- xwOBA against — estimated wOBA using exit velocity and launch angle, Statcast's own pitch-type-specific convention.

Predictor variables:

- Velocity, spin rate, induced vertical break (IVB), horizontal break, and release extension — taken directly from Statcast, averaged per pitcher-season.
- Vertical Approach Angle (VAA) — calculated from each pitch's raw trajectory, then averaged across a pitcher's four-seamers for the season.
- Release height was deliberately excluded from the regression model. Release height and VAA are highly correlated ($r = -0.74$), since a higher release point mechanically flattens the approach angle on an otherwise identical pitch. This analysis treats VAA as the relevant readout of release point, rather than a confound to control away.

Correlation Matrix

Before modeling, all candidate predictors and outcomes were checked against each other for raw association.

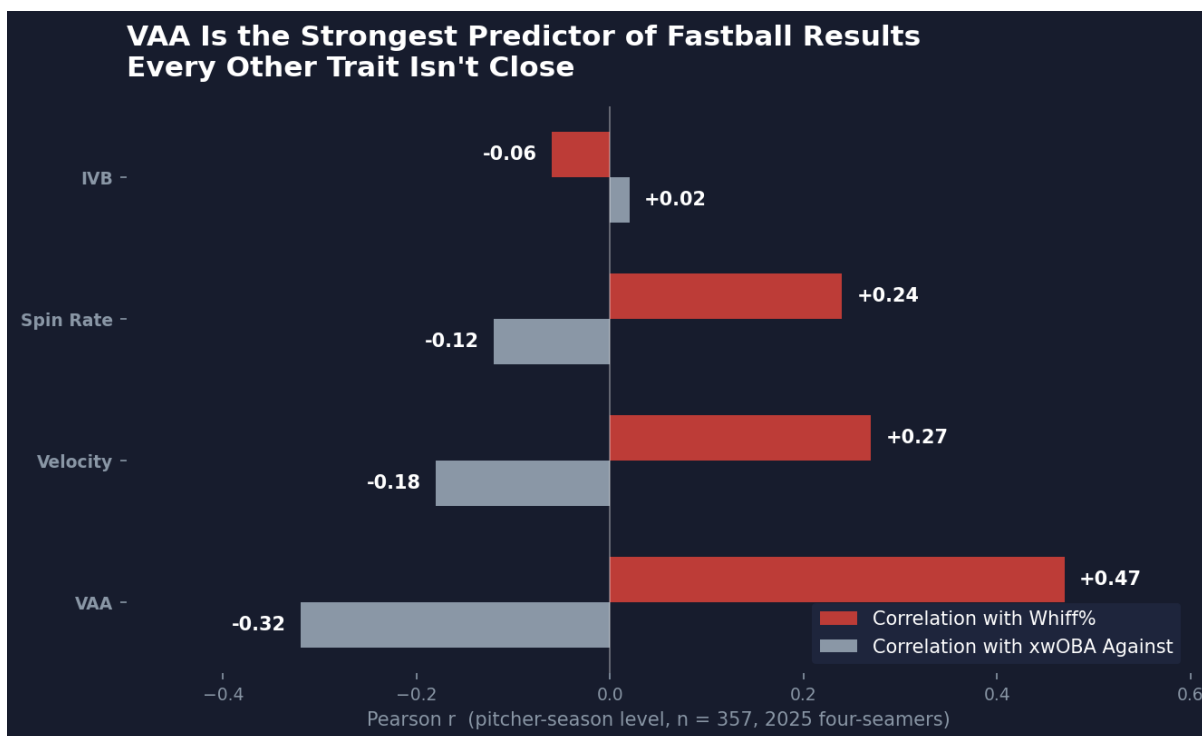


Figure 1. Pearson correlation, pitcher-season level, n = 357 (2025, 200+ four-seamers).

- VAA is the strongest correlate of both outcomes — $r = 0.47$ with whiff% and $r = -0.32$ with xwOBA. No other trait comes close on either outcome.
- IVB is essentially uncorrelated with results on its own — $r = -0.06$ with whiff% and $r = 0.02$ with xwOBA — despite being the trait most commonly used as fastball-shape shorthand.
- Release height and VAA are highly correlated ($r = -0.74$), confirming VAA is substantially mechanical rather than an independent shape trait.

Regression Results

Standardized regression coefficients (per 1 SD change in predictor). Whiff% model $R^2 = 0.283$; xwOBA model $R^2 = 0.120$. VAA is the only predictor that is significant and substantial in both models. Velocity is a significant secondary contributor to whiff% but washes out for xwOBA. Spin rate, IVB, and extension are not statistically distinguishable from zero in either model once VAA is accounted for.

Case Study: Elite Results From an “Unremarkable” Shape

If IVB were the right shorthand for fastball quality, pitchers with middling velocity and below-average IVB shouldn't be able to miss bats or suppress contact at an elite level. Two pitchers in the 2025 sample are useful counter-examples precisely because their fastballs look ordinary on a standard Trackman readout, but their release angle is not.

Joe Ryan — 2025 Four-Seam Profile

Metric	Value	League Percentile
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Velocity	93.7 mph	33rd
IVB	13.7 in	18th
Spin Rate	2,295 rpm	41st
VAA	-3.85° (flat)	96th
Whiff%	23.2%	78th
xwOBA Against	.279	91st (9th lowest)

Ryan's velocity and IVB both sit closer to the bottom third of the league than the top — an average-shape fastball by conventional evaluation. But his release angle produces a VAA in the 96th percentile of flatness, and elite results follow.

Logan Webb — 2025 Four-Seam Profile

Metric	Value	League Percentile
Velocity	92.8 mph	20th
IVB	10.7 in	2nd
Spin Rate	2,118 rpm	6th
VAA	-3.75° (flat)	97th
Whiff%	32.1%	97th
xwOBA Against	.169	best in sample (357 of 357)

That connects to a bigger point: no pitch exists in a vacuum. Webb's sinker is a real weapon in its own right, and it also changes how his fastball plays — a fastball that looks unremarkable on a pure movement chart can be elite once you account for what it's tunneling off of and what the hitter's eyes are already tracking. Judging a fastball purely on its own IVB number, in isolation, misses exactly this kind of case.

The takeaway for evaluation: it's not enough to just look at a movement plot to evaluate a fastball. Release point, location, and approach angle deserve more weight than they get, and no single pitch — including the fastball — should be graded apart from the arsenal it's part of. When scouting pitchers, it's important to look beyond just outlier movement, and chase outlier angles and complementary arsenals.