Optimizing Pitcher Roles in Major League Baseball

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Distinguishing between Starters and Relievers
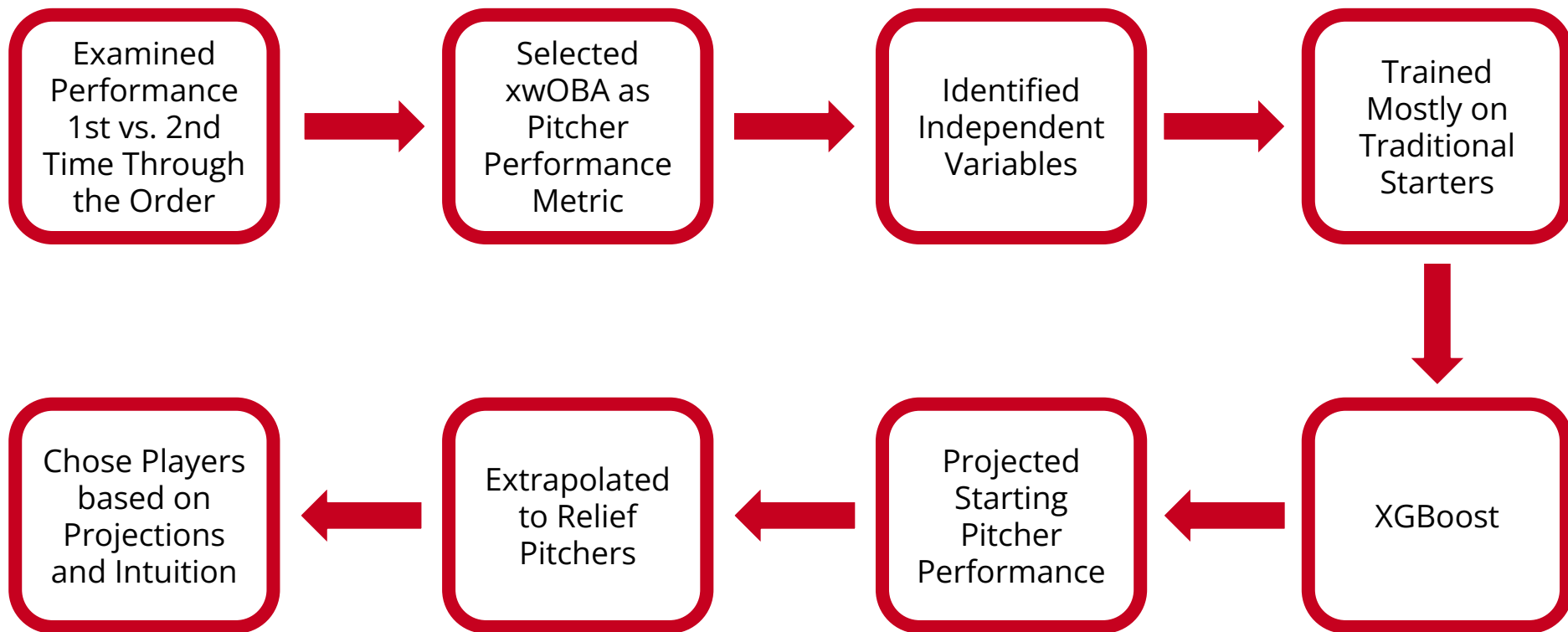
Starters | Relievers

Pitchers - STL	IP	H	R	ER	BB	K	HR	ERA
Martinez	6.0	7	3	3	3	4	0	3.34
Siegrist	1.0	0	0	0	0	1	0	2.80
Bowman	1.0	1	0	0	0	0	0	3.58
Oh	2.0	1	0	0	1	4	0	1.96
Duke (L, 2-1)	0.2	2	1	1	2	1	0	2.55
Totals	10.2	11	4	4	6	10	0	

Pitchers - CHC	IP	H	R	ER	BB	K	HR	ERA
Lester	6.0	5	2	2	1	6	1	2.93
Wood, T (BS, 1)	0.2	3	1	1	0	1	1	2.78
Smith, Joe	0.1	1	0	0	1	0	0	3.86
Grimm	1.0	0	0	0	0	1	0	4.46
Chapman	1.0	0	0	0	0	0	0	1.85
Montgomery, ... (W, 4-5)	2.0	1	0	0	2	4	0	2.54
Totals	11.0	10	3	3	4	12	2	

Methodology

Examined Performance 1st vs. 2nd Time Through the Order → Selected xwOBA as Pitcher Performance Metric → Identified Independent Variables → Trained Mostly on Traditional Starters

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XGBoost

Projected Starting Pitcher Performance ← XGBoost

Extrapolated to Relief Pitchers ← Projected Starting Pitcher Performance

Chose Players based on Projections and Intuition ← Extrapolated to Relief Pitchers

Two separate models incorporating xwOBA:

- TTO 1
  - Baseline measure of pitcher quality
- TTO Diff (1 - 2)
  - Ability to maintain effectiveness
- Example contains 9 TTO observations

Pitcher Example: German Marquez			
Batter	**TTO 1**	**TTO 2**	**TTO Diff**
Mookie Betts	0.832 (1B)	0.576 (L9)	0.256
Corey Seager	0.519 (1B)	0.135 (G4)	0.384
Justin Turner	0.211 (GDP)	0.397 (1B)	-0.186
Cody Bellinger	0.692 (BB)	0.979 (1B)	-0.287
Max Muncy	0.064 (G3)	0.692 (BB)	-0.628
Chris Taylor	0.158 (1B)	0.692 (BB)	-0.534
Gavin Lux	0.280 (GDP)	0 (K)	0.28
Austin Barnes	0.692 (BB)	0.692 (BB)	0
Clayton Kershaw	0.233 (1B)	0.221 (G5)	0.012
Total	**0.409**	**0.487**	**-0.078**

Possible traits involved in maintaining
success multiple times through a lineup:

- Maintaining velocity within
  an outing
- Pitch Repertoire
  - Diversity
  - Stuff
  - Location
- Ability to pitch to each
  batter handedness
- Efficiency (pitches/batter)

- Change in velocity of a pitchers fastest pitch
  - Must be thrown 10% of the time, and at least 6 times in an appearance
- Exclude first 3 pitchers
  - Evidence of velocity warm-up
- Exclude outing with less than 20 pitches
- Aggregated on season level

Lucas Sims: Four-Seam Fastball		
Pitch Number	Fastball Number	Velocity
2	1	94.8
5	2	94.0
6	3	94.1
9	4	94.1
14	5	93.2
15	6	94.3
16	7	94.5
18	8	92.7
19	9	94.7
22	10	93.3
23	11	93.2
Velocity Slope: -0.023		

$$S_v = \frac{\text{avg}(V_3:V_1) - \text{avg}(V_3:V_1)}{\text{avg}(P_3:P_1) - \text{avg}(P_3:P_1)}$$

- Usage percentage of all pitch types
- Stuff+ and Location+ (Fangraphs)
- These metrics account for distribution, quality and command of pitch repertoire
- Pitchers with better stuff, command and more pitches, will have less dropoff second TTO
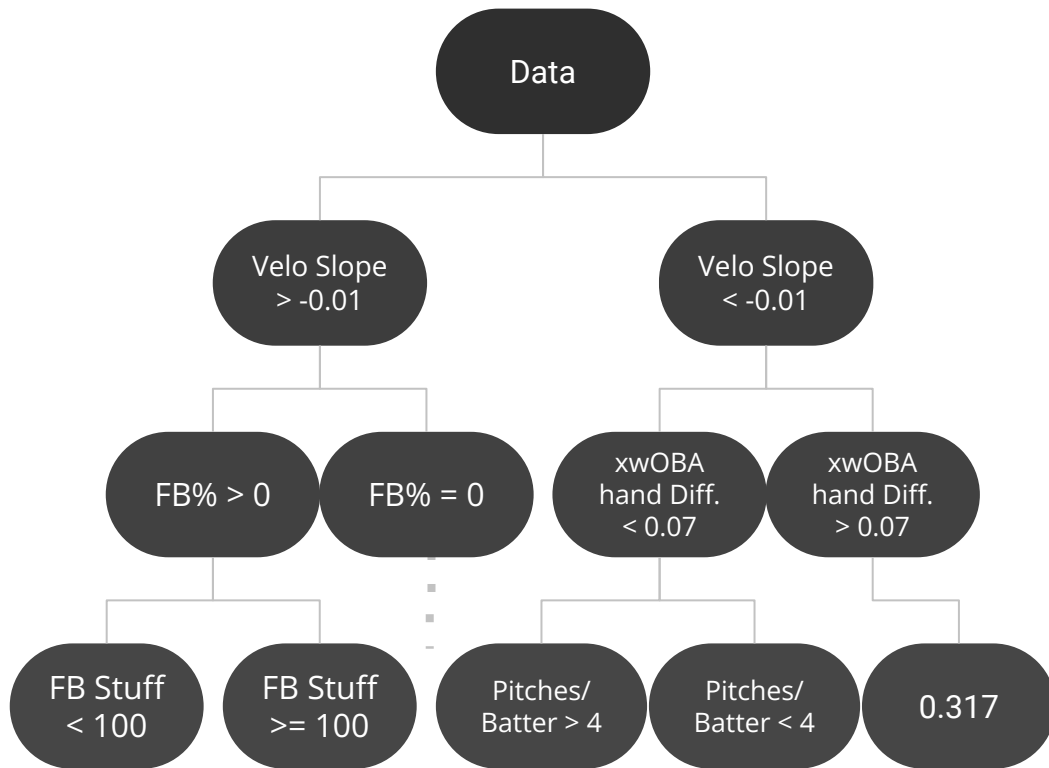
- Pitcher's ability to get both LHB and RHB out
- Absolute value of difference between xwOBA against both handedness
- Right skew distribution
- Pitchers who can face both batters effectively will be more successful in longer outings.
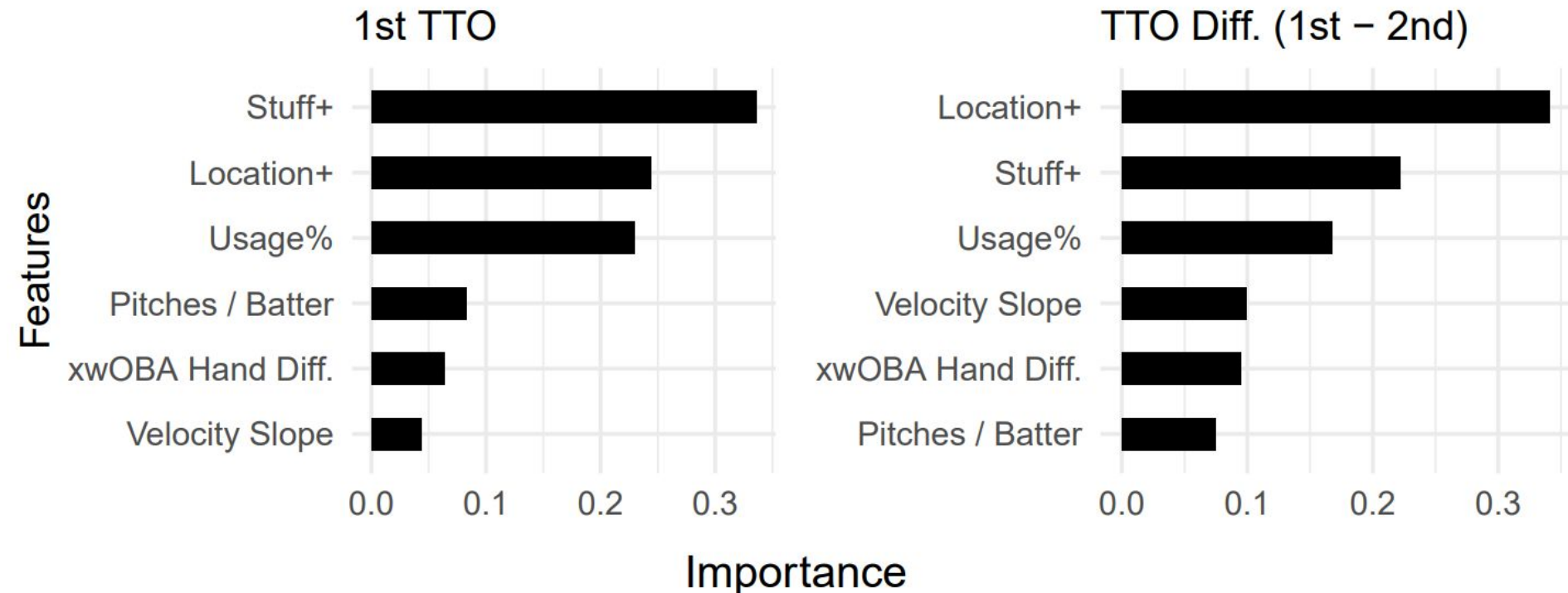
Handedness Splits Distribution for All Pitchers 2021-2023
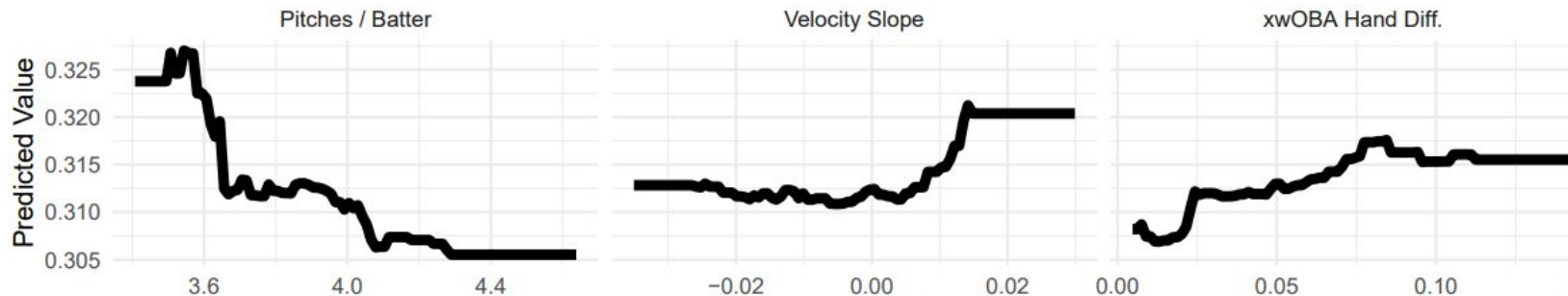
Decision Tree Example
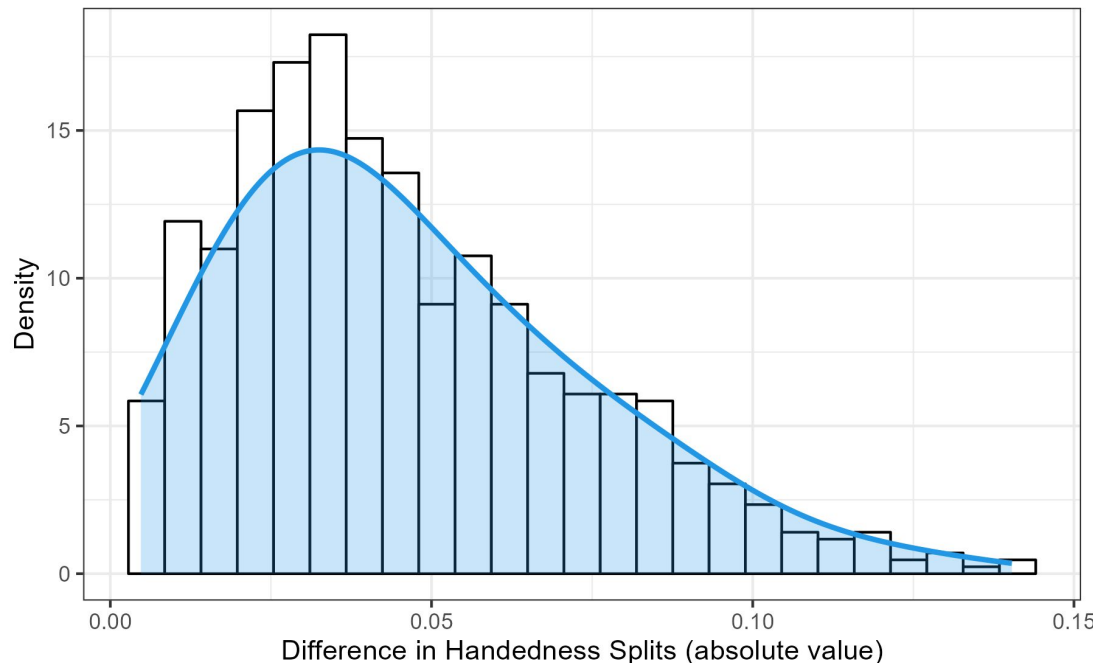
- Sample Adjustments
  - Pitcher-season level
  - 200 pitch minimum
  - 20 TTO observation minimum
  - Regress toward mean to weight variables
- Gradient Boosting (Tree)
- Captures nonlinear relationships
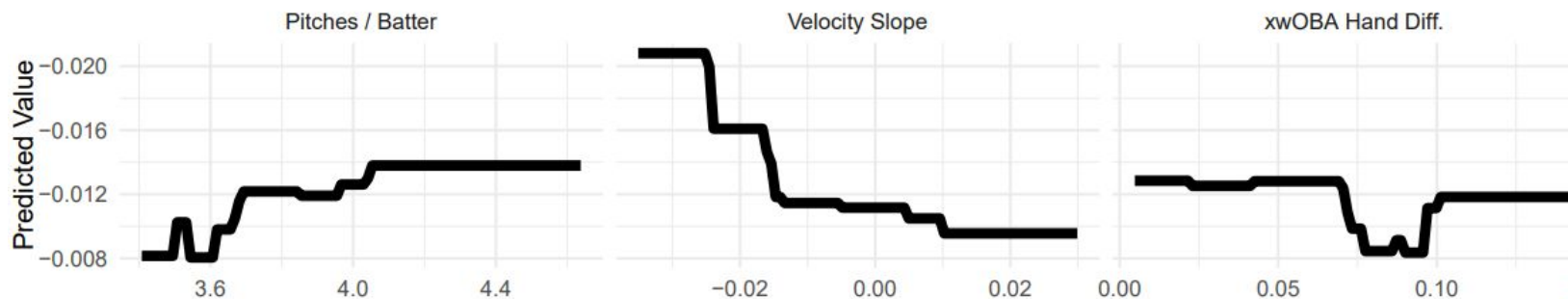- Grid search for hyperparameter tuning

Decision tree structure:

- Data
  - Velo Slope > -0.01
    - FB% > 0
      - FB Stuff < 100
      - FB Stuff >= 100
    - FB% = 0
  - Velo Slope < -0.01
    - xwOBA hand Diff. < 0.07
      - Pitches/Batter > 4
      - Pitches/Batter < 4
    - xwOBA hand Diff. > 0.07
      - 0.317

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Predicted xwOBA 1st TTO

Predicted xwOBA Diff. (TTO 1 – TTO 2)

Independent Variable Values

All Pitchers
- 2023 Pitchers
- No Swingmen

SP ➡ RP
- Average to bad TTO 1 projection (Model 1)
- Large difference in TTO 1 and TTO 2 projections (Model 2)

RP ➡ SP
- Good TTO 1 projection (Model 1)
- Small difference in TTO 1 and TTO 2 projections (Model 2)

Selecting Pitchers

SP ➡ RP

Pitcher	TTO1	TTO2	Difference	Aggregation
Triston McKenzie	0.298	0.321	-0.023	0.309
Michael Kopech	0.299	0.321	-0.023	0.310
Jake Irvin	0.311	0.333	-0.023	0.322
Carlos Rodon	0.292	0.314	-0.022	0.303
Grayson Rodriguez	0.274	0.295	-0.021	0.284
Aaron Nola	0.292	0.313	-0.021	0.302
Joe Ryan	0.295	0.315	-0.020	0.305
McKenzie Gore	0.303	0.323	-0.020	0.313
Tylor Megill	0.324	0.344	-0.020	0.334
Justin Verlander	0.303	0.322	-0.019	0.313
James Paxton	0.314	0.333	-0.019	0.324
Alex Marsh	0.320	0.338	-0.019	0.329
Graham Ashcraft	0.314	0.333	-0.019	0.324
Kyle Harrison	0.324	0.343	-0.019	0.333
Trevor Rogers	0.295	0.313	-0.018	0.304

RP ➡ SP

Pitcher	TTO1	TTO2	Difference	Aggregation
Robert Suarez	0.276	0.268	0.007	0.272
Ryan Pressly	0.269	0.281	-0.012	0.275
Paul Sewald	0.271	0.286	-0.015	0.279
Jordan Romano	0.280	0.279	0.001	0.279
Ryan Helsley	0.273	0.288	-0.015	0.281
Emmanuel Clase	0.278	0.287	-0.009	0.282
Joely Rodriguez	0.285	0.285	0.000	0.285
Ryne Stanek	0.276	0.294	-0.017	0.285
Bryan Abreu	0.281	0.293	-0.012	0.287
Reynaldo Lopez	0.281	0.297	-0.017	0.289
Brock Stewart	0.285	0.293	-0.008	0.289
Daniel Palencia	0.286	0.293	-0.007	0.290
Brooks Raley	0.285	0.296	-0.011	0.290
Griffin Jax	0.287	0.295	-0.008	0.291
Gerardo Reyes	0.285	0.297	-0.012	0.291

Percentiles are amongst 2021−23 Starting Pitchers
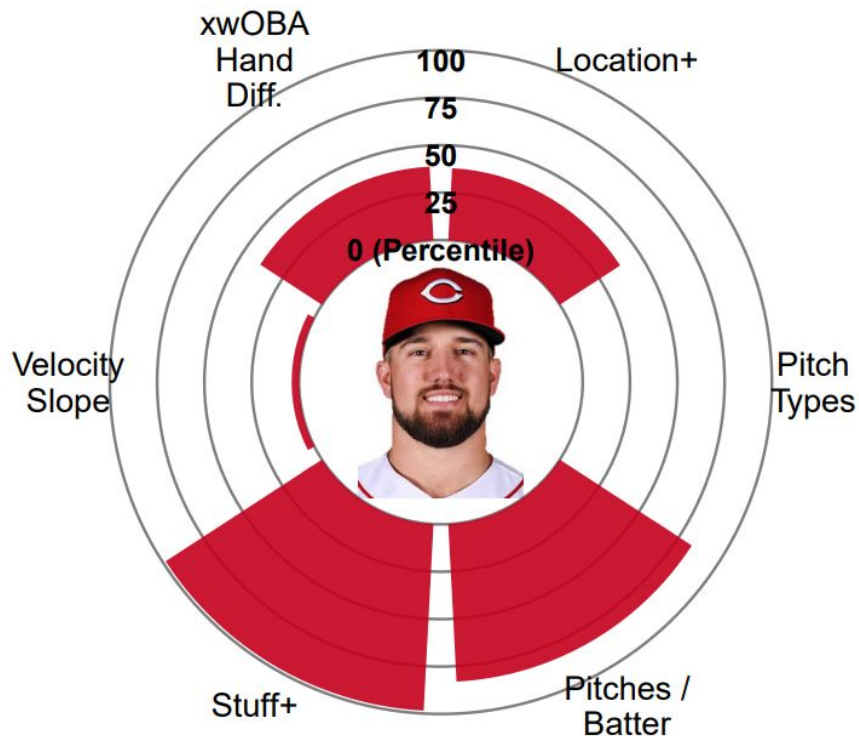
TTO1	TTO2	Difference	Aggregation
0.314	0.333	-0.019	0.324

Graham Ashcraft

Pitch	Usage%	Location+	Stuff+
Cutter	0.529	97.61	116.5
Slider	0.374	102.4	165.7
Sinker	0.097	89.82	56.86

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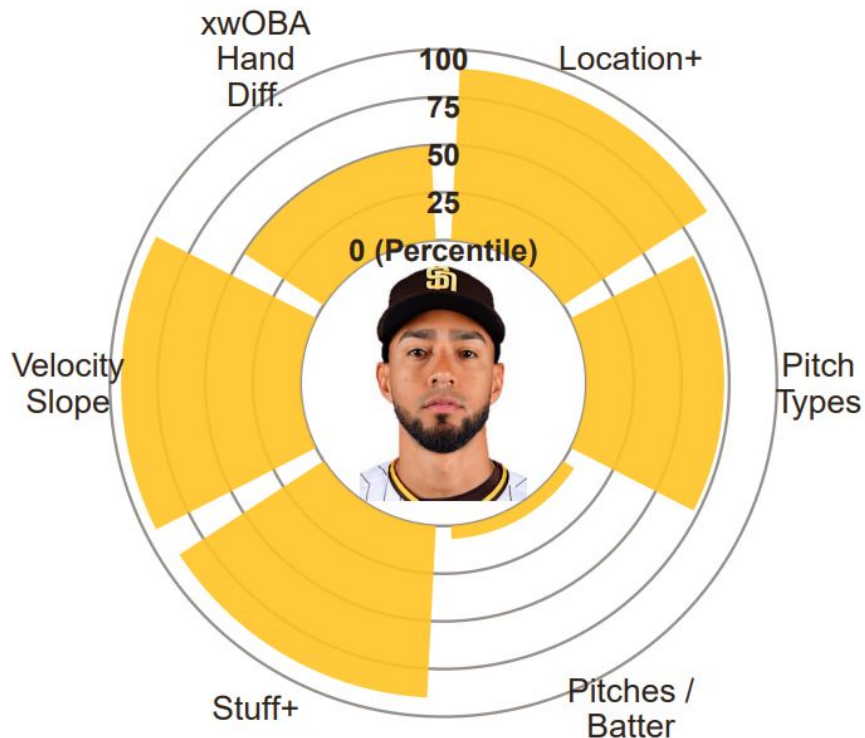
TTO1	TTO2	Difference	Aggregation
0.276	0.268	0.007	0.272

Robert Suarez

Pitch	Usage%	Location+	Stuff+
Fastball	0.365	109.1	128.4
Change-Up	0.336	102	111.9
Sinker	0.243	107.2	119.1
Slider	0.045	112.6	108.7

Thank You

Questions?