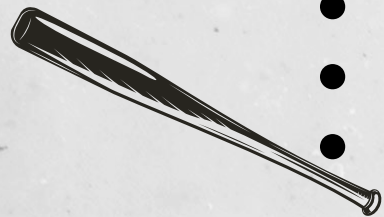# The Wrong Stuff

By: Liam Jennings, Isabelle Schmidt, and Tiger Teng

Defining Stuff+

- Stuff+ evaluates a pitch based on its physical characteristics (aka the nastiness of a pitch)
- Features include:
  - Velocity
  - Vertical and horizontal movement
  - Extension
  - Spin Rate (RPM)
  - Spin Axis
  - Release Point
  - Velocity and Movement Differences from Primary Fastball

Introduction

Questions:

- What variables are most important for an effective pitch?
- How well does Stuff+ evaluate the effectiveness of a pitch?
- How has Stuff+ and the effectiveness of pitches changed over time?
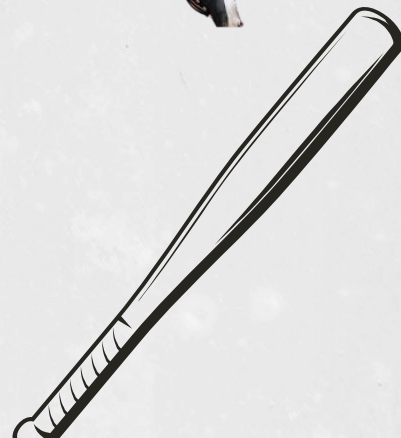
Data

FanGraphs

Average Stuff+ in a given season for each of the pitcher's pitch types

Baseball Savant

Aggregated pitch physical characteristics, release point, xwOBA, and Whiff% by pitcher, season, and pitch type

Undervalued? Overvalued?

Andrew Heaney & Julian Merryweather 4-Seam Fastball

| PLAYER NAME	SEASON	VELOCITY	EXTENSION	INDUCED VERTICAL BREAK	HORIZONTAL BREAK	SPIN	STUFF PLUS	WHIFF PCT	XWOBA
Andrew Heaney	2021	92.0	6.2	15.2	-15.3	2443	100.0	27.8	0.328
Andrew Heaney	2022	92.9	6.2	14.3	-14.8	2441	94.6	31.1	0.324
Andrew Heaney	2023	92.5	6.5	13.9	-15.9	2413	106.6	25.6	0.336
Andrew Heaney	2024	91.5	6.5	13.9	-15.7	2401	77.2	21.3	0.333
Julian Merryweather	2021	97.5	6.8	17.5	-7.7	2262	129.4	19.1	0.429
Julian Merryweather	2022	97.3	6.6	16.9	-6.5	2286	127.0	14.6	0.493
Julian Merryweather	2023	98.1	6.5	16.6	-6.3	2342	128.4	20.6	0.386
Julian Merryweather	2024	96.0	6.5	16.5	-5.7	2236	103.4	17.3	0.387

Bias in 4-Seam Fastball Stuff+
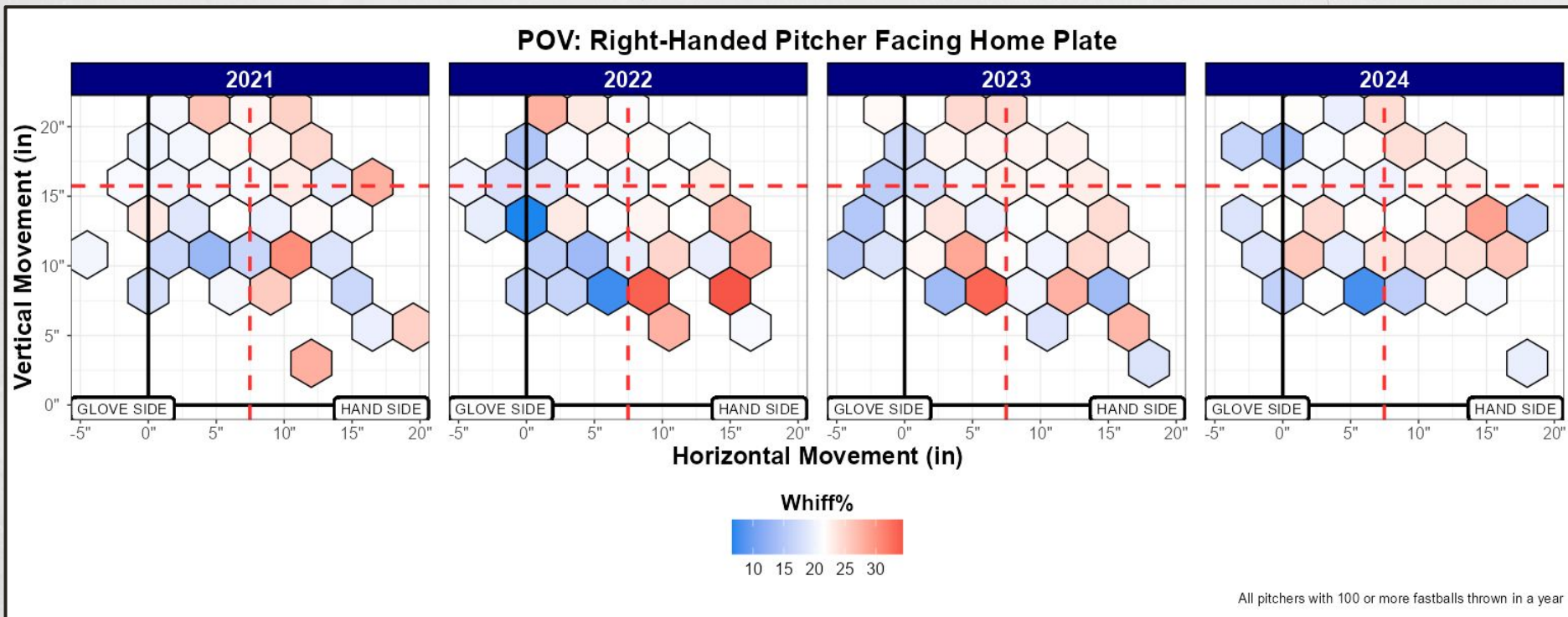
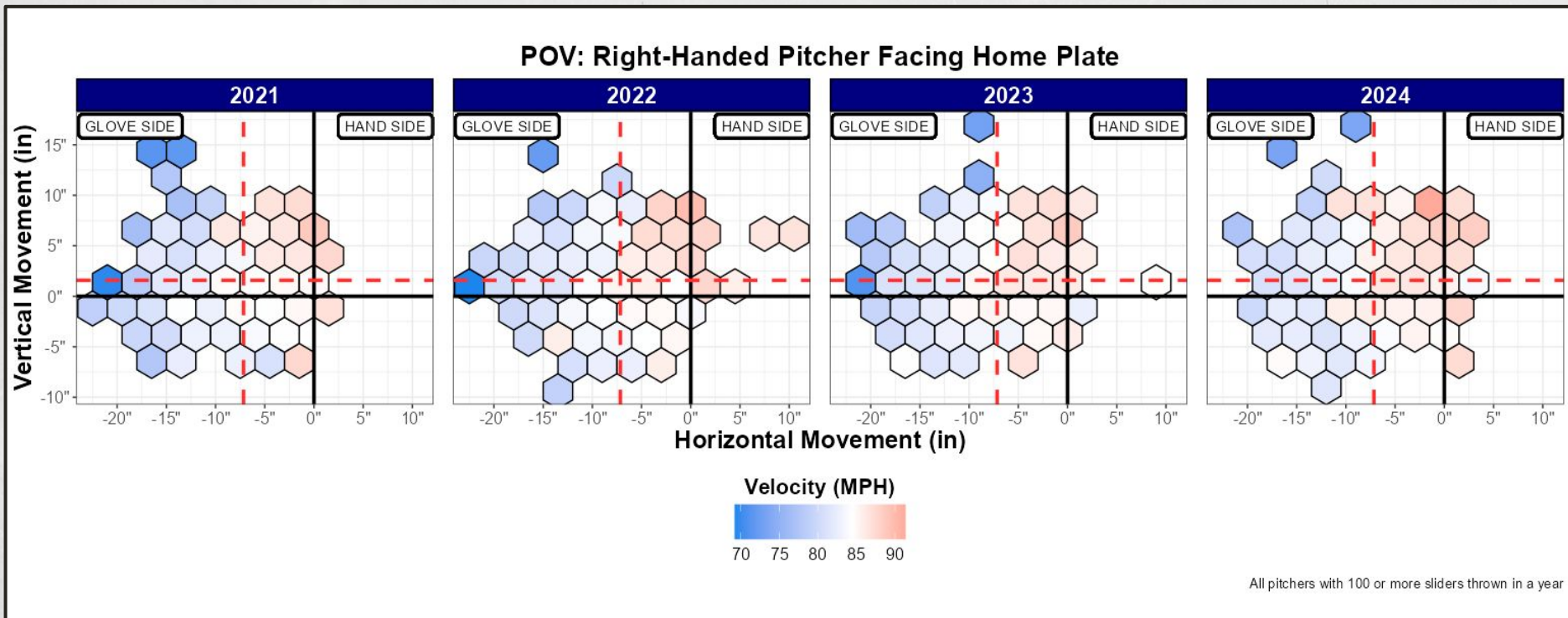# Bias in 4-Seam Fastball Stuff+
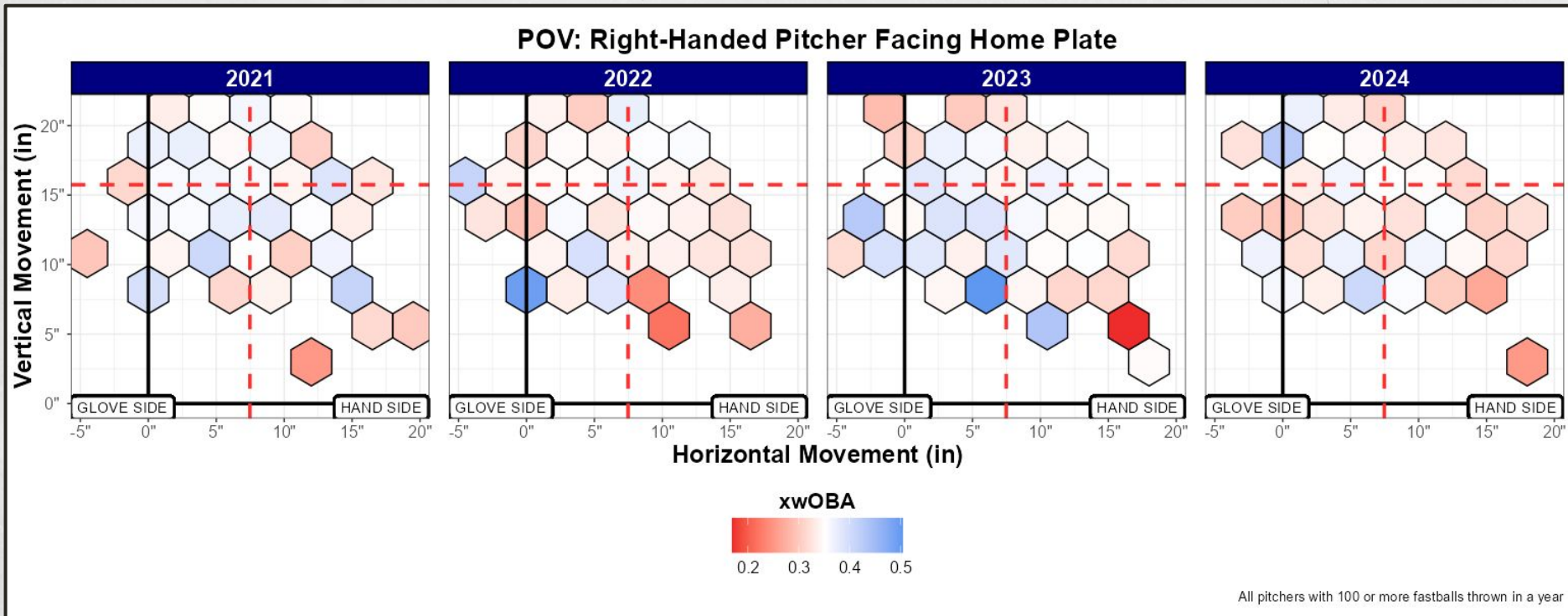
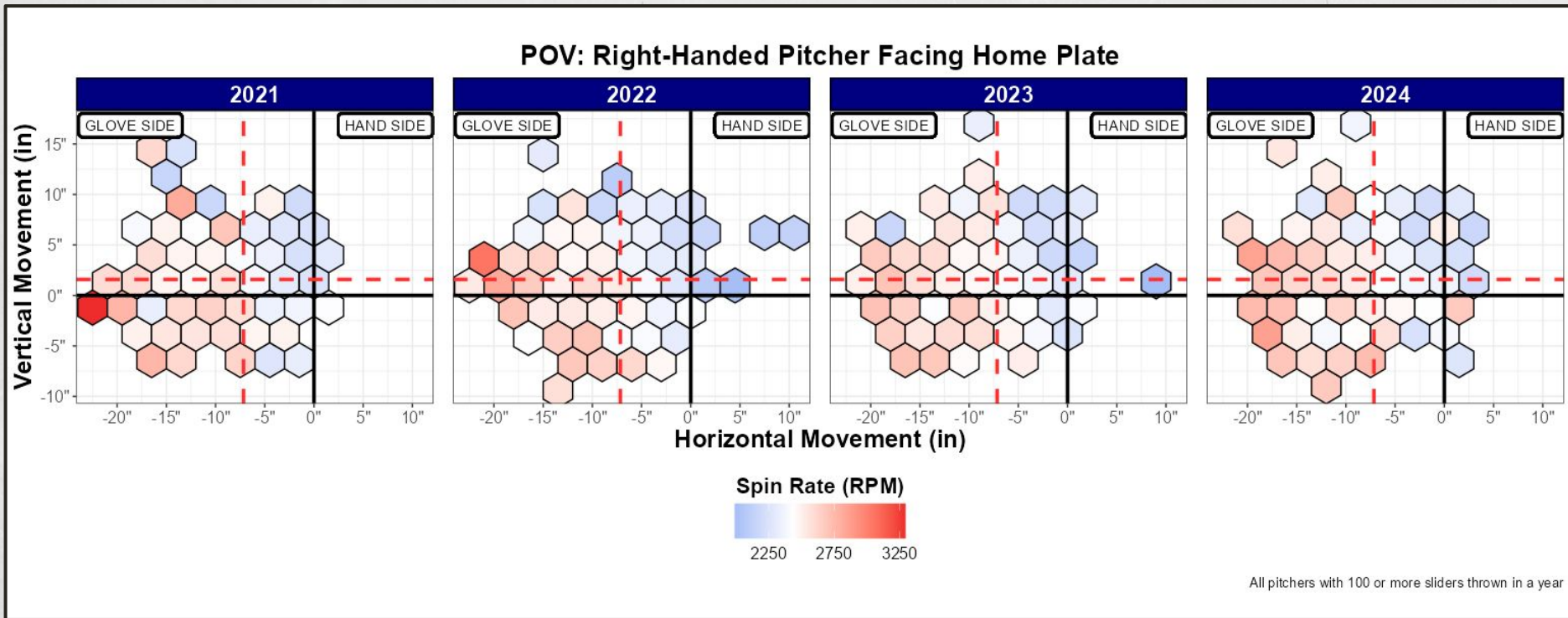# Bias in 4-Seam Fastball Stuff+
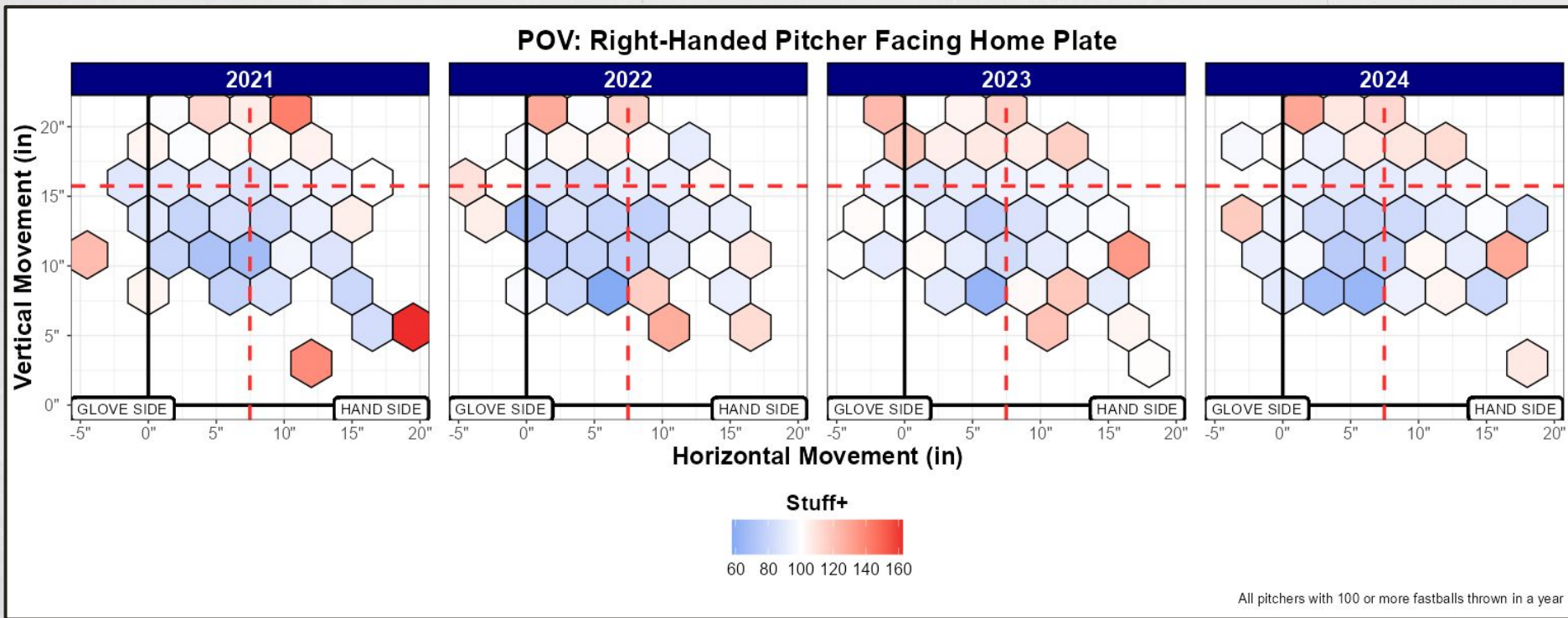
Bias in Slider Stuff+

Bias in Slider Stuff+

Sweepers and Sliders Shouldn't Be Classified the Same

Slider and Sweeper Differences

Comparing Pitch Physical Characteristics

PITCH NAME	VELOCITY (MPH)	SPIN RATE (RPM)	SPIN AXIS	HORIZONTAL BREAK (IN)	VERTICAL BREAK (IN)
Slider	85.22	2,416	143	5.42	1.66
Sweeper	81.75	2,570	120	14.27	1.30

Number of pitchers who threw 100+ Sliders: 699
Number of pitchers who threw 100+ Sweepers: 196

Sweeper and Slider Differences

POV: Right-Handed Pitcher Facing Home Plate
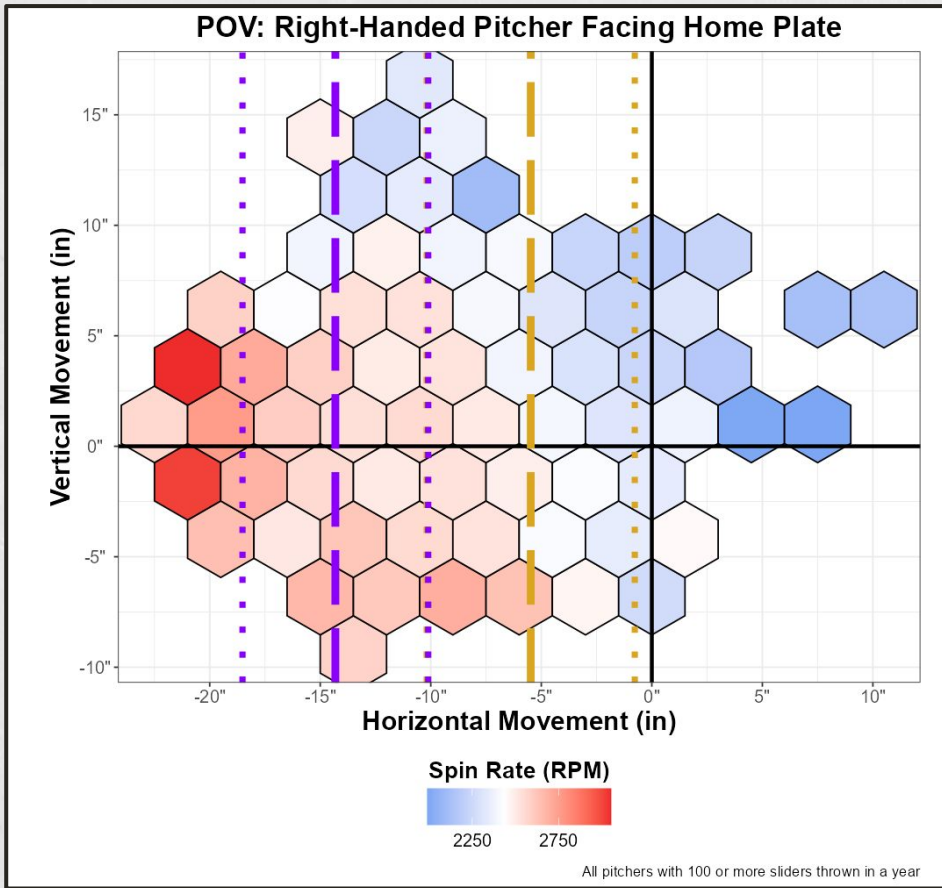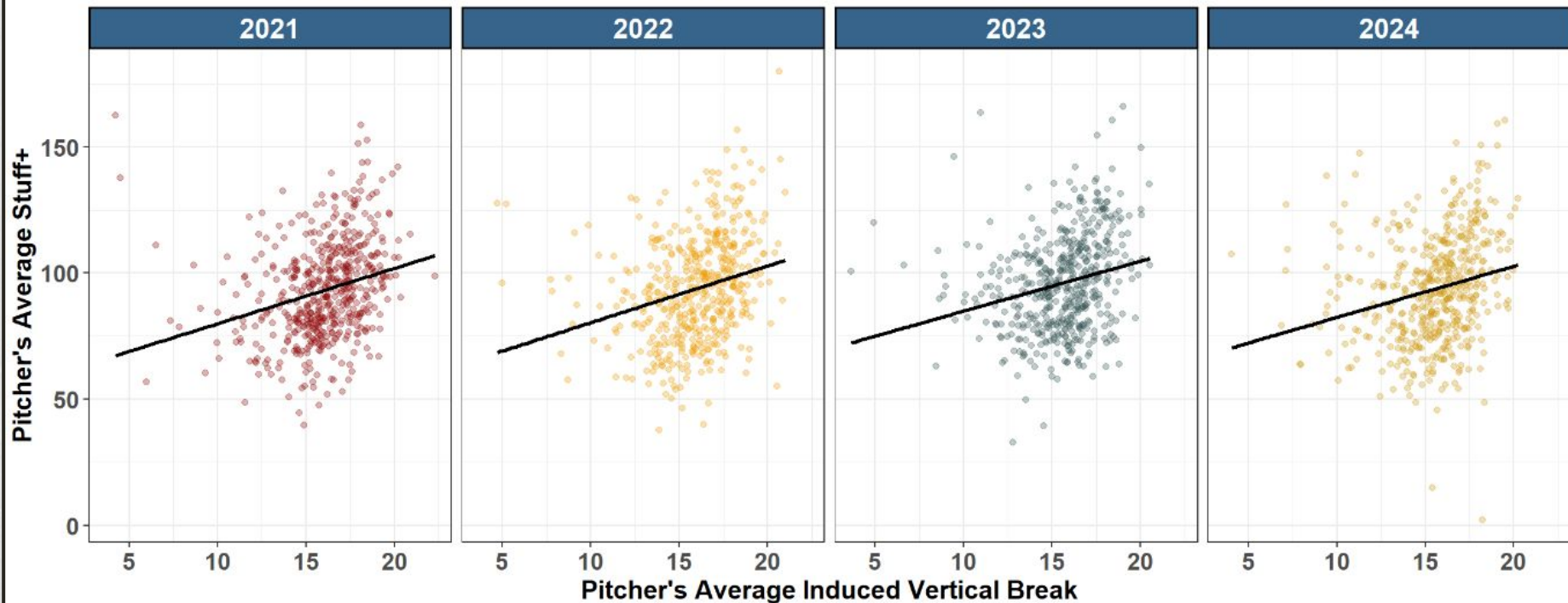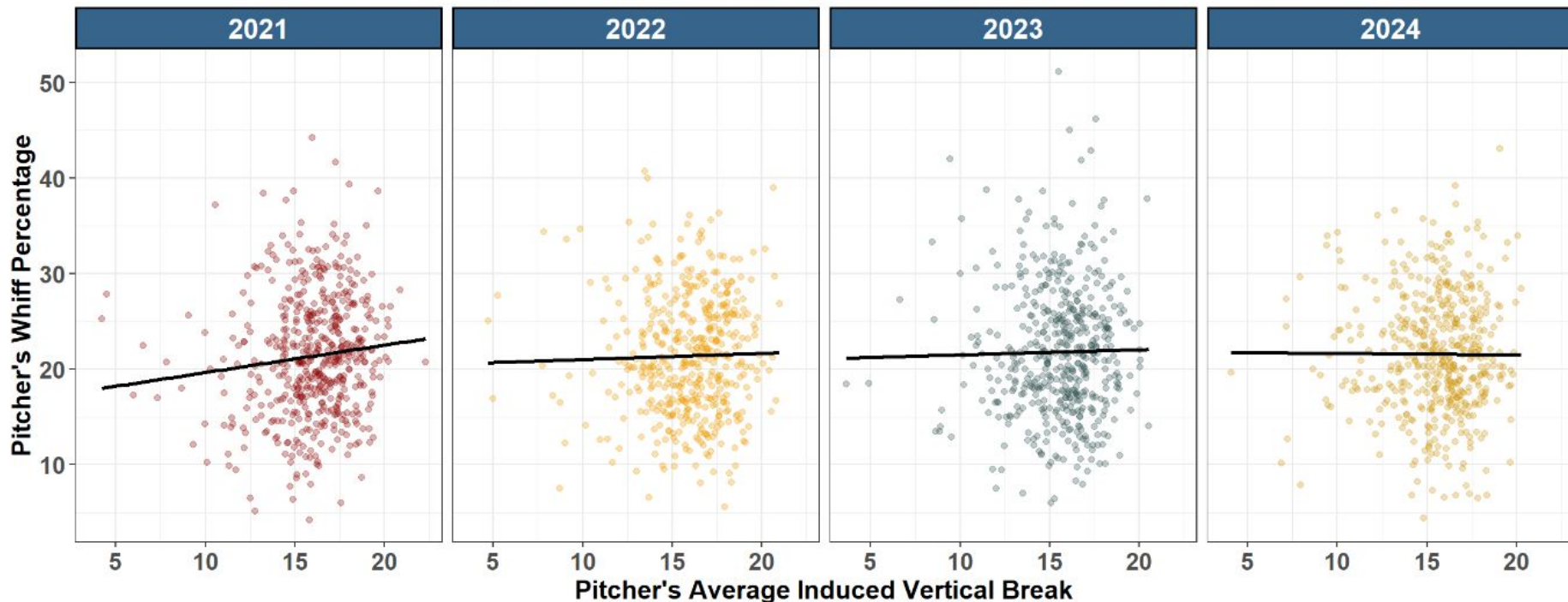
Sweepers

Sliders

Modeling Year-to-Year Change

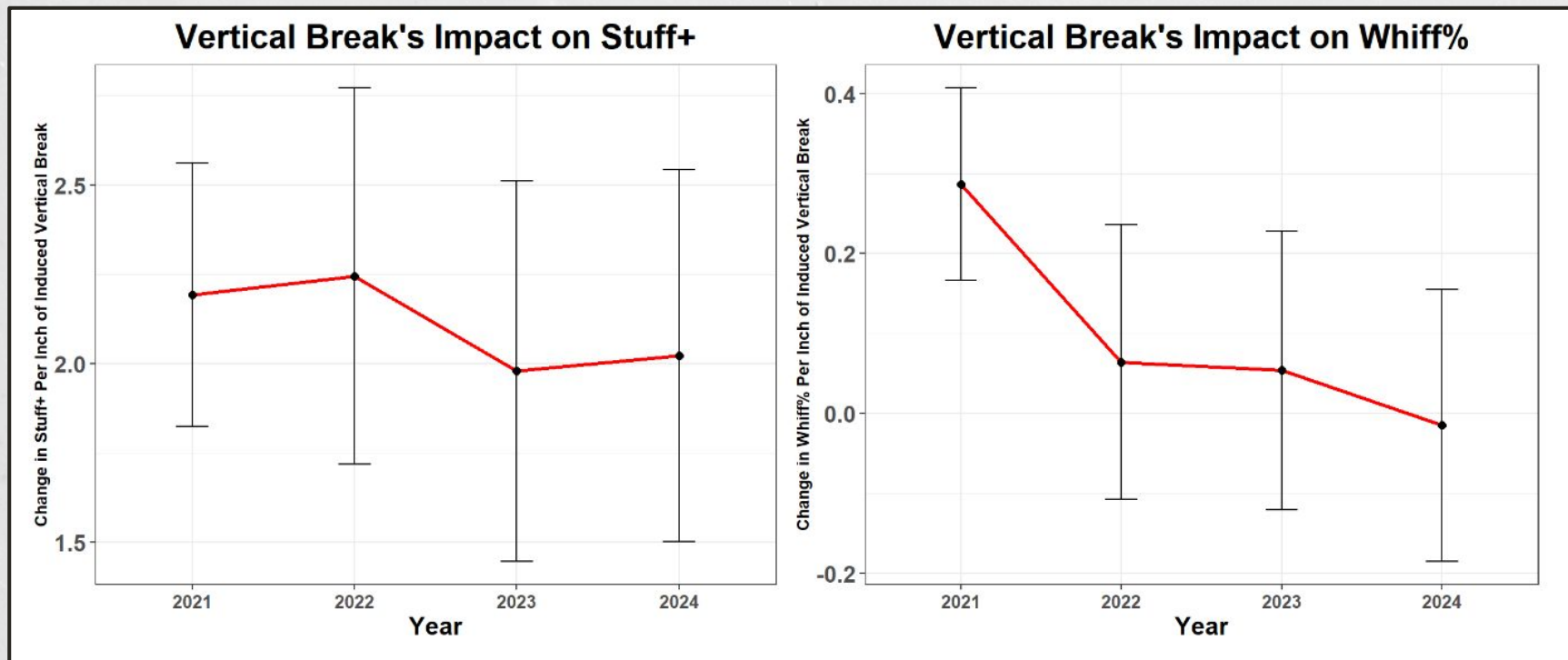Relationship Between Vertical Break And Stuff+ For 4-Seam Fastballs
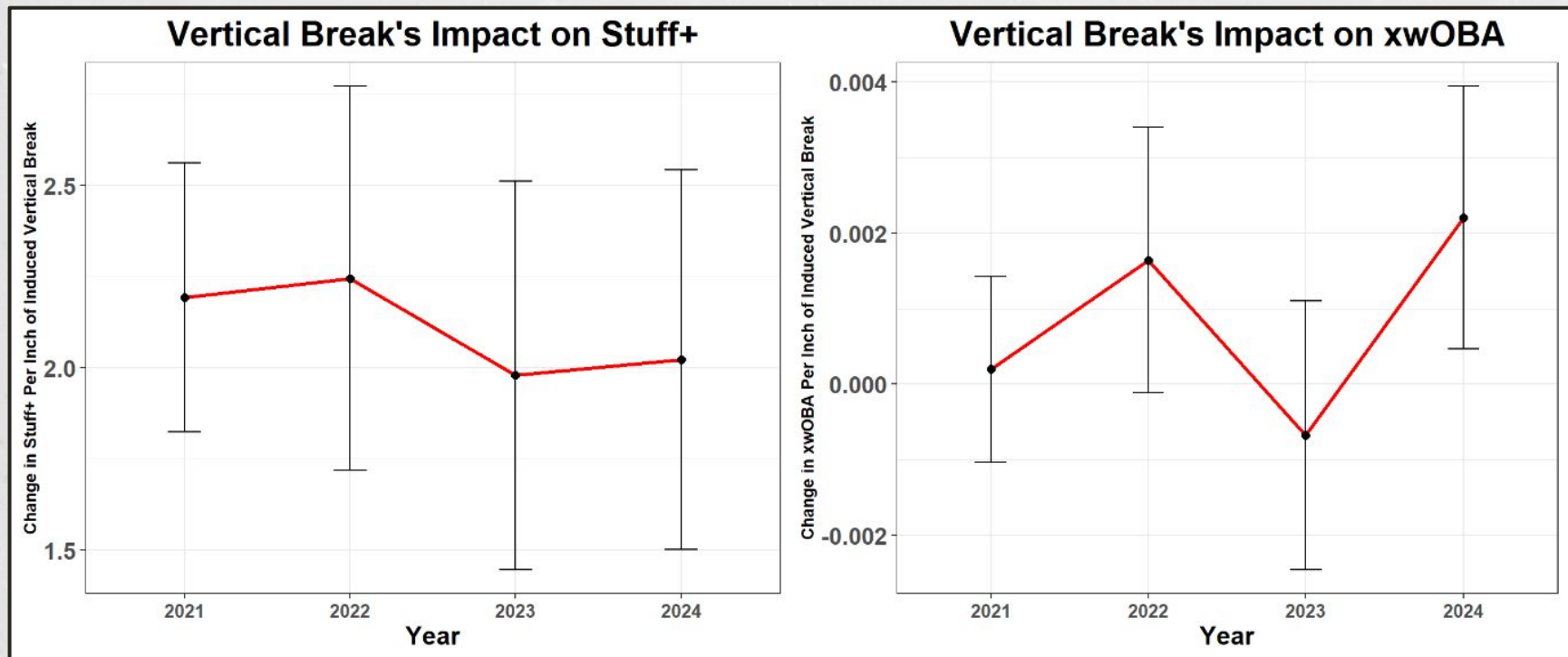
Modeling Year-to-Year Change

Relationship Vertical Break And Whiff% For A 4-Seam Fastball

How Well is Stuff+ Adjusted Year-to-Year?

How Well is Stuff+ Adjusted Year-to-Year?

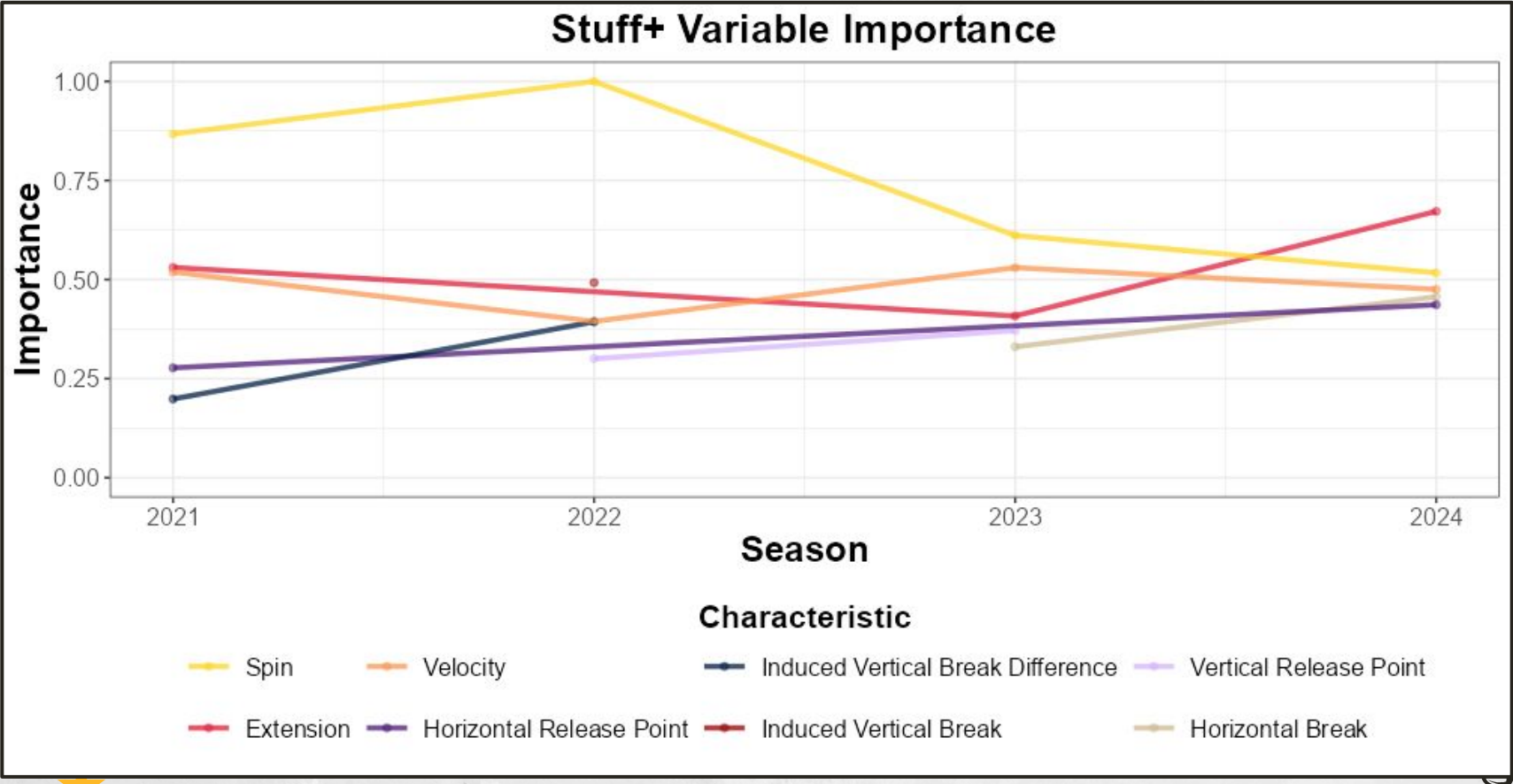# XGBoost over Random Forest

XGBoost
Random Forest
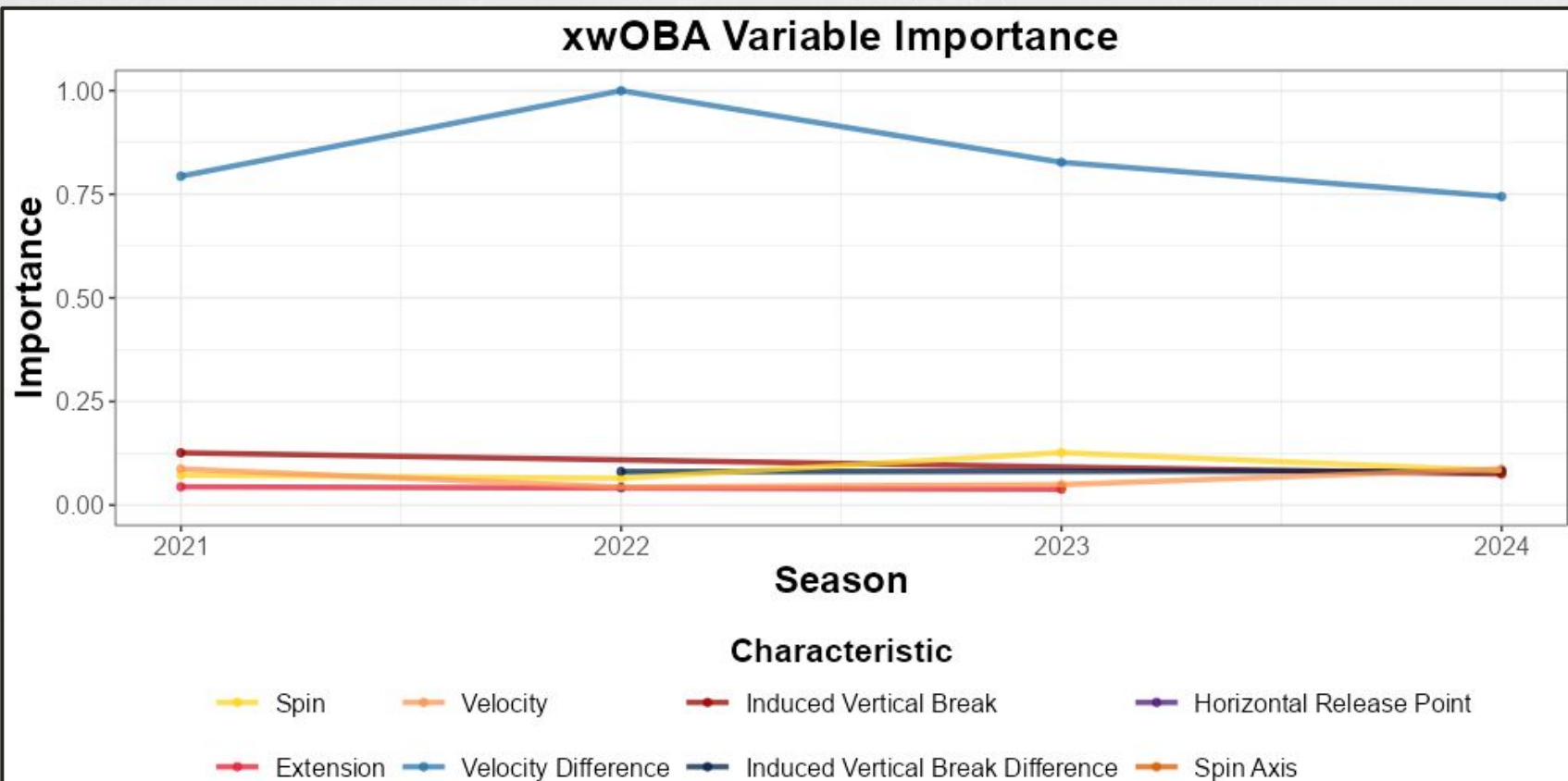
5-fold
Cross
Validation

XGBoost
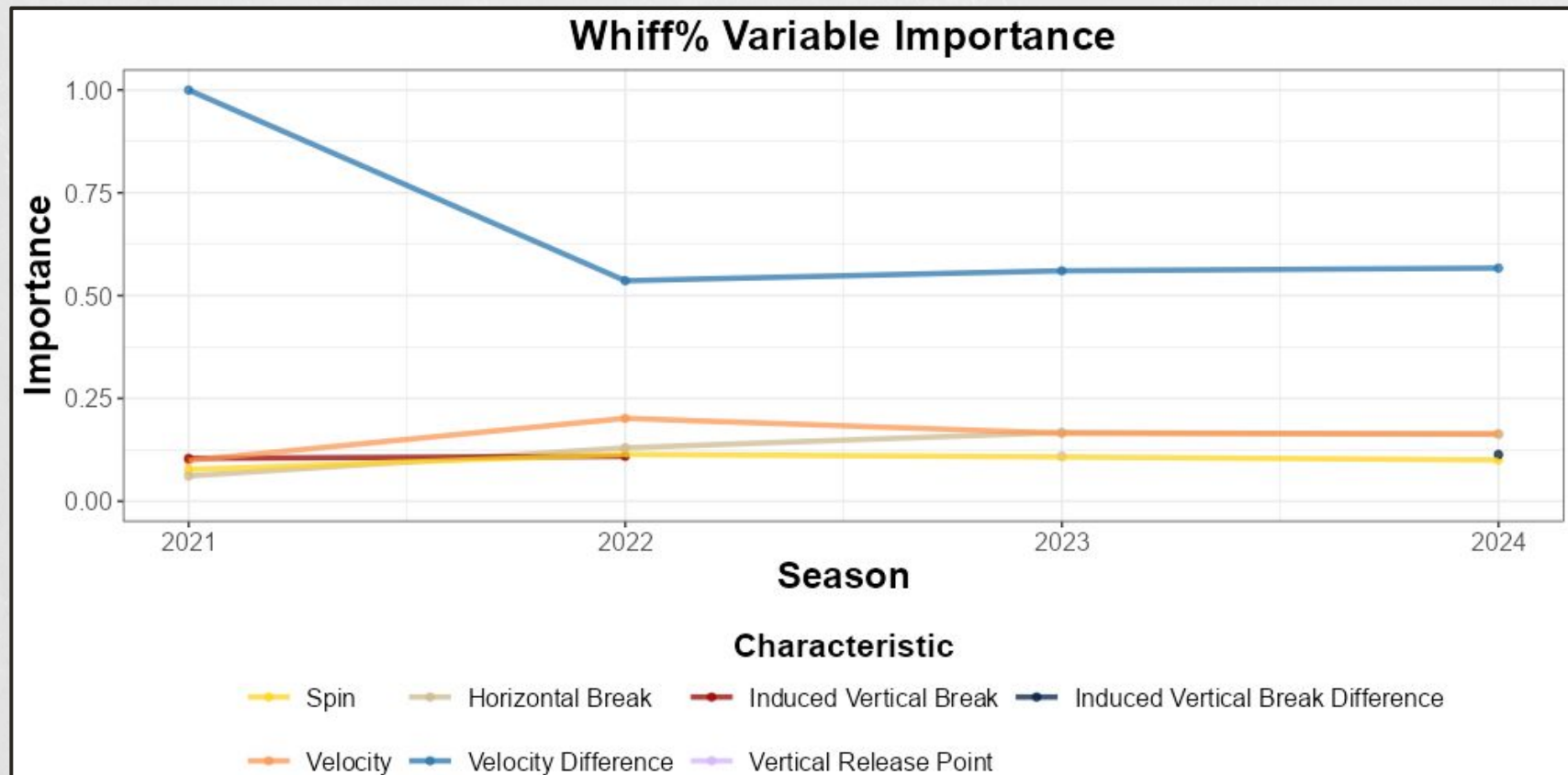
Spin, Extension, and Velocity Are Essential in Stuff+

Velocity Difference is Most Important

xwOBA Variable Importance

Velocity Difference is Most Important

Whiff% Variable Importance

Discussion

Limitation:

- Aggregated Data
- Limited Pitch Types
- Temporal Scope

Future Work:

- Look into Curveballs, Sinkers, and Changeups to see if there's any bias in these pitches Stuff+
- Create an open source Stuff+ model