Visual Assessments Predict Swing Propensity in Professional Baseball

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Background

- Baseball is an inherently visual sport with the need to track fast pitches and make rapid decisions to swing or not. As such, it is believed that better visual abilities may underlie better batting performance.
- In this work we sought to identify potential correlations between visual skills as measured in standardized testing batteries and hitting performance in a sample of 71 professional baseball players.
- If relationships are present, this information can be utilized to develop a more efficient and effective performance vision training program by targeting specific visual skills.

Methods

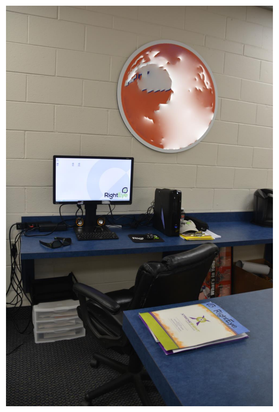
- Data from the standardized testing in the Senaptec Sensory Tablet and RightEye unit from 86 professional baseball players were collected during the spring of 2018.
- RightEye was used to measure eye tracking abilities and visual response speed, and Senaptec measured visual clarity, contrast sensitivity, near-far quickness, perception span, multiple object tracking and reaction time. Auto-refraction measures were also collected.
- During 2018 season, 109 players' at-bat performance were recorded with Trackman in a pitch-by-pitch format. These data were modeled to generate standardized propensity scores for three plate discipline measures: O-Swing%, Z-Swing%, and Z-Miss%. These variables were merged with visual-assessment variables, resulting in the final sample of 71 players.
- Analyses featured four nested regression models:
  - Model 1: Performance - Autorefraction + Senaptec + RightEye
  - Model 2: Performance - Senaptec + RightEye
  - Model 3: Performance - RightEye
  - Model 4: Performance (constant intercept)

Plate Discipline statistics tell us how often a hitter swings and makes contact with various defined pitches or how often a pitcher induces swings or contact on various pitches.

Propensity Definitions

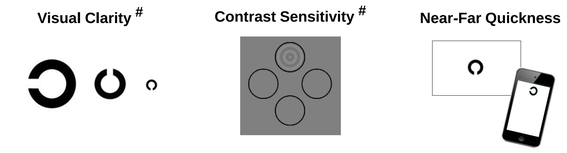
- **O-Swing %**, number of swings at pitches outside the strike zone divided by the number of pitches seen outside the strike zone. Lower values are preferred.
- **Z-Swing %**, number of swings at pitches inside the strike zone divided by the number of pitches seen inside the strike zone. Lower values indicate more discerning batters.
- **Z-Miss %**, defined as the number of missed swings at pitches inside the strike zone divided by the number of swings at pitches inside the strike zone. Lower values are preferred.

RightEye



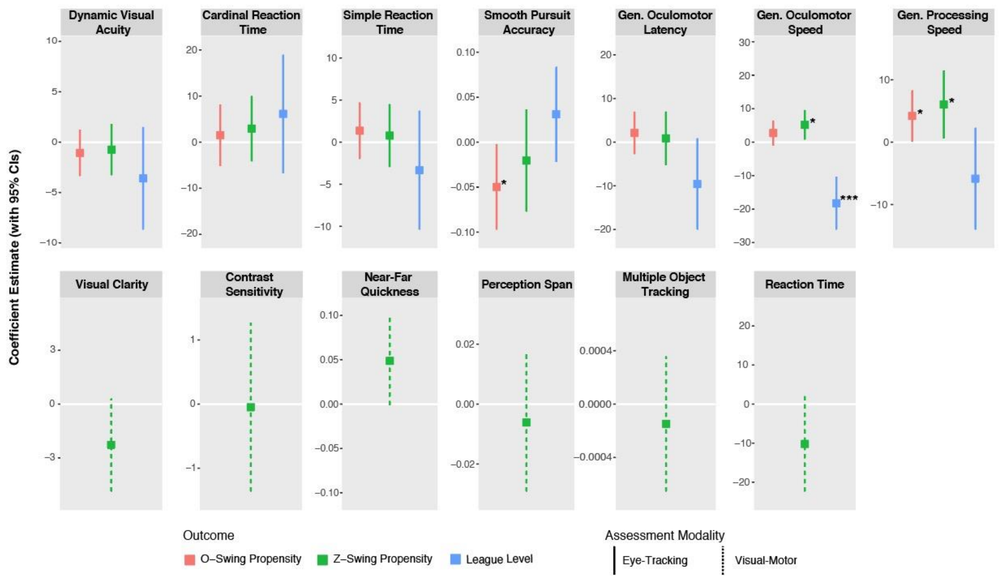
- Dynamic Visual Acuity
- Cardinal Reaction Time
- Simple Reaction Time
- Smooth Pursuit Accuracy
- General Oculomotor Latency
- General Oculomotor Speed
- General Processing Speed

Senaptec



Results

- Better performance in smoothly tracking visual object, $t(56.84) = -2.10$, $p = .04$, and faster speed in discriminating visual targets, $t(56.58) = 2.04$, $p = .05$, were identified to predict lower O-Swing propensity. This finding implies that batters can reduce their O-Swing propensity through enhancement of ball tracking and faster speed in processing information related to pitch recognition.
- Faster speed in discriminating visual targets, $t(53.49) = 2.23$, $p = .03$, and faster oculomotor speed, $t(53.64) = 2.37$, $p = .03$, were found to predict lower Z-Swing propensity. Given that a lower swing tendency from batters was correlated to a higher contact rate, this finding can be understood in that better pitch tracking and faster oculomotor movement help batters become more discernible in their swings: they only swing at pitches likely to result in fair plays.
- No visual assessment variables were found to predict Z-Miss propensity.



	O-Swing (Model 3)		Z-Swing (Model 2)		League Level (Model 3)	
	est(SE)	p val	est(SE)	p val	est(SE)	p val
DVA (s)	-1.06(1.14)	0.35	-0.74(1.26)	0.56	-3.59(2.53)	0.16
CRT (s)	1.50(3.30)	0.65	2.93(3.53)	0.40	6.14(6.39)	0.34
Simple RT (s)	1.36(1.67)	0.42	0.78(1.85)	0.67	-3.32(3.52)	0.34
Smooth Pursuit Acc (%)	-0.05(0.02)	0.04*	-0.02(0.02)	0.47	0.03(0.02)	0.24
Oculomotor Lat (s)	2.10(2.42)	0.38	0.86(3.02)	0.77	-9.57(5.19)	0.07
Oculomotor Speed (s)	2.72(1.85)	0.14	5.17(2.18)	0.02*	-18.2(3.92)	< 0.01***
Processing Speed (s)	4.19(2.05)	0.04*	6.04(2.70)	0.03*	-5.86(4.06)	0.15
Visual Clarity (logMAR)			-2.28(1.29)	0.08		
CS (log)			-0.04(0.65)	0.94		
NFQ (score)			0.04(0.02)	0.05		
PS(score)			-0.00(0.01)	0.59		
MOT (score)			0.00(0.00)	0.55		
Reaction Time (s)			10.2(6.07)	0.09		

Conclusion

Better abilities in visual object tracking, oculomotor movement, and visual target discrimination, collected during the pre-season, predicted lower O-Swing propensity and Z-Swing propensity. These findings may be used to predict better plate discipline, useful in scouting, advancement and setting batting order. They may also be used to identify 'targets-of-opportunity' for more relevant training programs.

References

Liu, S., Edmunds, F., Burris, K., & Appelbaum, L. G. *Visual and oculomotor abilities predict professional baseball batting performance.* Manuscript submitted for publication.