

Sports Vision and Major League Baseball: East Coast Pro Showcase

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INTRODUCTION

Every year, the Major League Baseball Association (MLB) holds a week-long training camp and showcase for the best high school baseball players across the country to hone and display their skills; some athletes are drafted directly into the MLB after the showcase. Those schools East of the Mississippi River attend the "East Coast Pro Showcase" (ECPS) in Syracuse, New York, in August.

As part of the showcase, the players have vision screenings performed to assess their visual skills. Every year since 2012, The SUNY College of Optometry has sent a team of optometrists and students to perform the screenings.

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Data from the various screening tests performed were compiled and scored using a 5-point derived scoring system designed for the screenings, and individualized reports were created for each athlete and provided to the MLB.

The data from the 2014 ECPS are displayed here, and they provide interesting insight into the visual skills present in top athletes. Implications and suggestions for future testing are provided.

Vision Screenings: Areas of Examination



Nine Areas of Examination Reported to the MLB

1) Visual Acuity

- Snellen Acuity OU, OD, OS
- Chart minimum letter size: 20/10

2) Dynamic Visual Acuity

- 20/60 (@10 ft)
- 20/30 (@10 ft)
- Sherman rotating disc is set to 90 rpm. Speed is reduced until line is read. RPM is recorded.



3) Eye/Hand Coordination ("proaction")

- Wayne Saccadic Board: program 9.1|2.30
- Lights appear. When athlete presses light, new light appears in random position.
- Recorded: Maximum number of lights athlete can hit in 30 seconds.

4) Visual Reaction ("reaction")

- Wayne Saccadic Board: 9.11|2.36
- Light appears in random position every 0.75 sec.
- Recorded: maximum number of lights athlete can hit in 30 sec. (*Maximum possible is 36*)



5) Visual Adjustability ("action")

- Wayne Saccadic Board: program 9.21|2.30
- Similar to "reaction," except instead of a new light appearing every 0.75 sec., the time interval is adjusted based on the athlete's speed. When the athlete presses light, a new light appears in a random position after a short delay. If the athlete's speed slows, the interval from one light to the next is lengthened; if his speed increases, it is shortened.

6) Depth Perception

- Stereopsis (Wirt Circles @ 80 cm)
(40 cm test distance doubled in order to measure stereopsis as low as 10" or arc).



7) Fusion Flexibility

- Distance Brock String. Batting Position

8) Visual Speed

- Rheem Tachistoscope @ 1/100 sec.
- player sits 4 ft. from screen
- Set of 6 digits is flashed @ 1/100 sec. Player reports as many digits as he can remember.
- Test is conducted 3 times; total number of correct digits is added (*maximum is 18*).



9) Focus Flexibility (pass/fail)

- "Distance PRA"
- Minus lenses (-1.50 sph) held OU while athlete views distance Hart Chart at 10 ft.

Other tests performed, not included in MLB data or reports:

- Hyperopia check test (blur with +1.50 OU)
- Distance Cover Test
- Near Cover Test
- NPC (right gaze, center gaze, left gaze)
- Pursuits
- Saccades
- Worth 4 Dot
- Brock String, Standing (Distance and Near)
- Brock String, Batting (Near)
- Contrast Sensitivity (with and without glare)
- Ocular Health (pupils, EOM's, direct ophthalmoscopy)

Scaled Scores: Quantitative to Qualitative Analysis for MLB

Scaled Scores:

- Derived from z-scores
 - Mean set to 10; Standard Deviation set to 3
 - Scaled Score = $10 + 3z$

SCALED SCORES (associated perceptive lower limits below)																			
Poor					Below Average		Low Avg.	Average				High Avg.	Above Average		Superior				
1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	
0.2	0.4	1.0	2.3	4.8	9.2	16.0	26.0	37.0	50.0	64.0	75.0	85.0	50.9	95.3	97.8	99.1	99.7	99.9	

Qualitative Analysis and MLB Scores

- “MLB” Scores”: 5-point scaling system derived from Scaled Scores
- The 9 areas of examination reported to the MLB were scored using this “MLB Score” with the exception of focus flexibility, which was pass/fail.

Sealed Score	MLB Score	Description
≤5	1	poor
6-8	2	below average
9-11	3	average
12-14	4	above average
≥15	5	superior

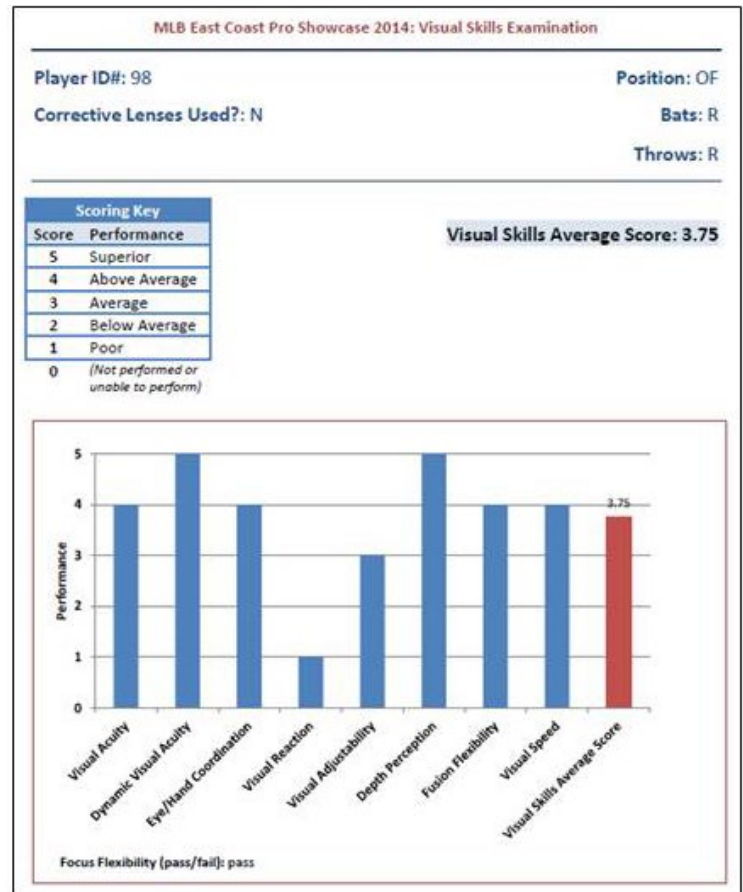
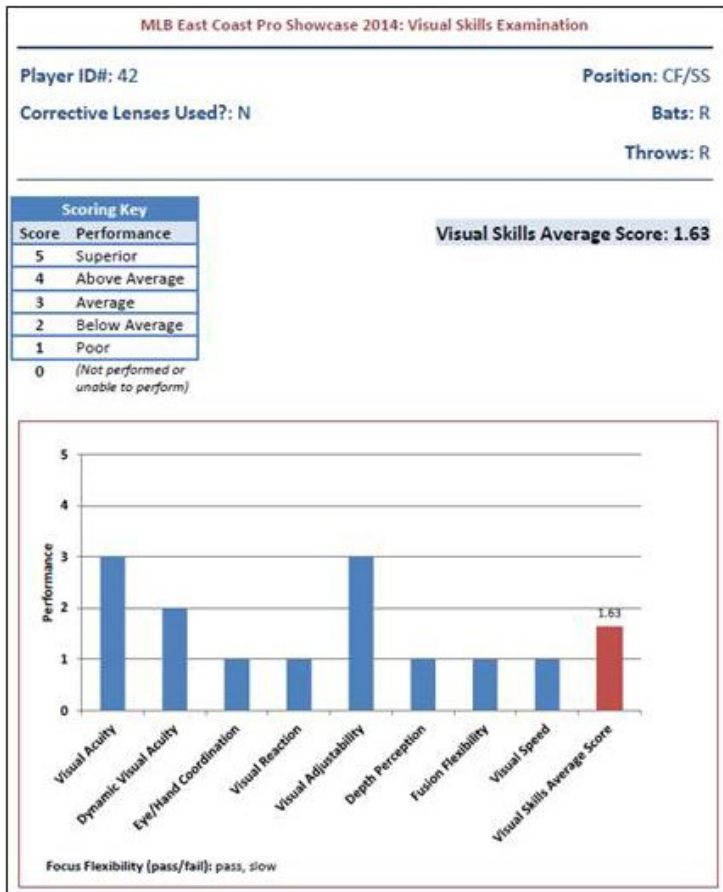
MLB Individualized Score Reports

Reports were generated for each athlete and given to the MLB. Each report displays the athletes’ performance on the 9 areas of examination, as well as a “Visual Skills Average Score,” which averages all of the (eight) tests scored with the MLB Score. An example of an athlete with weak visual skills and one with strong visual skills are shown on the right:

Combined Data from 2013 and 2014 MLB ECPS Vision Screenings

DISCUSSION

Analysis of the data shows patterns – some expected, some unexpected – that may help guide examination of athletes and provide areas for further Sports Vision research.



(n=238)		Mean	StDev	Min	Median	Max
Distance VA	OD	20/17	23.88 ft	20/10	20/15	20/400
	OS	20/16	5.05 ft	20/10	20/15	20/50
	OU	20/14	2.65 ft	20/10	20/13	20/25
Cover Test*	DCT	-0.0Δ	0.7Δ	06Δ	0Δ	+4Δ
	NCT	-2.2Δ	3.5Δ	-12Δ	-2Δ	+8Δ
Brock String* Distance	Standing	+4.2 ft	3.3 ft	0.0 ft	+4.0 ft	+17.0 ft
	Batting	+4.7 ft	3.3 ft	0.0 ft	+5.0 ft	+15.0 ft
Brock String* Near	Standing	+0.1"	9.0"	-96.0"	0.0"	+36.0"
	Batting	+0.4"	10.5"	-54.0"	0.0"	+120.0"
NPC	rightNPC	2.8"	2.1"	1"	2"	10"
	ctrNPC	2.8"	1.7"	1"	2"	7"
	leftNPC	2.7"	1.8"	1"	2"	7"
Stereopsis	Wirt Circles	32.9" arc	36.4" arc	5" arc	20" arc	200" arc
Dynamic VA	DVA 20/60	59.8 rpm	9.9 rpm	34 rpm	60 rpm	85 rpm
	DVA 20/30	35.2 rpm	8.2 rpm	12 rpm	35 rpm	61 rpm
Wayne Saccadic Board	Proaction	37.4	4.4	24	37	49
	Reaction	27.6	3.9	15	28	36
	Action	25.1	4.1	9	25	38
Tachistoscope	Tach@1/100	13 5/18	3.0	4/18	14/18	18/18

(For over Test and Brock String, "+" denotes eso; "-" denotes exo)

# failed hyperopia test (+1.50)	18 (6.7%)
# failed dist PRA (-1.50)	100 (37.3%)
# wearing Rx:	70 (26.1%)

Visual Acuity in High Performing Athletes

The mean OU VA of athletes at ECPS 2013 & 2014 was 20/14. With a standard deviation of 2.65 ft. (Snellen Denominator), an athlete with 20/20 VA would actually fall in the 1.2 percentile of acuity. This underlines the importance of both of measuring VA and refracting beyond 20/20 in athletes.

Eso Posture at Brock String

The majority of athletes demonstrated eso posture during the Brock String test, whether standing or batting, both at distance and near. This could be an anticipatory adaptation the athletes use to hit balls coming at them at 90 mph. Alternatively, it may be a handicap, for which vision training could help. Further research could elucidate which is the case, perhaps by correlating batting averages with binocular posture, or training athletes out of their eso posture and evaluating whether batting statistics improve or not.

Focus Flexibility ("Distance PRA") High Failure Rate

A striking number of athletes (37.3%) failed the focus flexibility test, during which -1.50 lenses are placed over the athlete's distance Rx, and the patient is asked to clear a distance Hart Chart placed at 10 ft. This is likely due to the interaction between accommodation and convergence; poor negative relative vergence (BI ranges) will result in poor positive relative accommodation. Based on Morgan's norms,¹ the average distance NRV "break" is expected at 7Δ; in order to avoid

diplopia, an athlete with average an NRV break would need to have an AC/A ratio of <4.67 Δ/D when accommodating through -1.50 lenses.

$$(7\Delta \div 1.50D = 4.67 \Delta/D)$$

PRA/NRV "cycle":

- ↑ Blur-Drive Accommodation
- ↑ Accommodative Convergence
- ↓ Disparity Vergence
- ↓ Convergent Accommodation

While accommodation in the distance is not a natural visual task, like other "unnatural" tests

(PRA, NRA, PRV, NRV, etc.), "focus flexibility" can demonstrate a patient's or athlete's overall flexibility and interaction between their accommodative and convergence systems. Further research and testing could elucidate whether athletes with better focus flexibility perform better on the field, and if so, this skill could be trained with therapy to improve performance.

CONCLUSION

Baseball players within this cohort demonstrated excellent visual skills. Using a derived scaled scoring system to compare

players' performance within the visual skills categories illustrated here can help assist MLB scouts in player selection. Future studies would be useful to correlate results of specific tests with player performance.

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