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A study investigating a season's baseball performance while wearing SportSight soft contact lenses: phase III

Abstract

Background: The use of tinted lenses in competitive sport is well known. Contact lens (CL) integration of wavelength-specific filters may provide significant performance enhancement and visual advantages in baseball compared to tinted spectacles.

Methods: Five wavelength-specific filters were tested and two were chosen for use by the Pacific University 2003 baseball team. Twenty collegiate baseball players were fitted with both SportSight™ Amber42 and Amber66 soft contact lenses for wear during practices and games for a full season. The performance of the study participants was evaluated by comparing batting average, slugging percentage, on base percentage, and fielding percentage. Pitching performance was evaluated by comparing earned runs on average per nine innings, walk to strikeout ratio, hits allowed per inning, and accuracy. Performance statistics were compared under two tinted CL conditions and one no tint condition.

Results: There were no statistically significant differences in any of the performance measures evaluated in this study. However, there was a trend for most athletes to perform better while wearing a SportSight tinted CLs versus wearing no tint. Subjective results also revealed perceived visual and performance benefits to wearing SportSight tinted CLs.

Conclusion: Overall baseball batting, fielding, and pitching performance showed a tendency to improve when athletes wear SportSight tinted CLs. While the results are not statistically significant, any actual or perceived improvement in visual performance and psychological "edge" can make a considerable difference in an athlete or team's performance. Therefore the SportSight CLs may be beneficial to baseball players.

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Degree Name

Master of Science in Vision Science

Committee Chair

Alan W. Reichow

Keywords

sportsight, baseball, performance enhancement, contact lenses, tinted lenses, colored filters

Subject Categories

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A STUDY INVESTIGATING A SEASON'S BASEBALL PERFORMANCE
WHILE WEARING SPORTSIGHT™ SOFT CONTACT LENSES: Phase III

By

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A thesis submitted to the faculty of the
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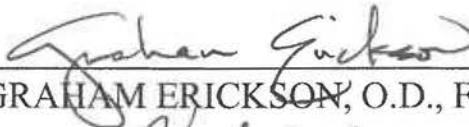
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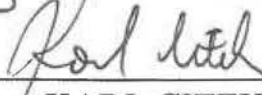
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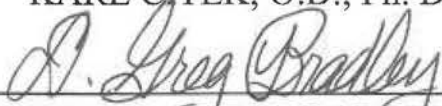
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Biographies

Jared Pearson was born and raised in Lake City, SD. He graduated from North Dakota State University in 1999 with a Bachelor of Science in Zoology. He attended Pacific University College of Optometry from 2001 to 2005 and plans to graduate with a Doctor of Optometry Degree in May 2005. He plans to join a primary care optometry somewhere in the United States. He is an avid fisherman and baseball fan.

Tara Peterson was born and raised in Pierre, SD. She graduated from Minnesota State University Moorhead in 2001 with a Bachelor of Arts Degree in Biology before pursuing a Doctor of Optometry degree from Pacific University College of Optometry. Tara plans to join a group practice and specialize in pediatric optometry and sports vision. She would like to return to the Midwest or any area with snow and waterskiing nearby.

Kyle Smith grew up in Clear Lake, Iowa and attended Wheaton College in Wheaton, Illinois, where he received a Bachelor of Science Biology. He has been involved in Amigos Eyecare at Pacific University and was the treasurer for the Armed Forces Optometric Society, Local Chapter. He enjoys running, bicycling, and singing, and will begin his optometric career in the United States Army upon graduation.

Abstract

Background: The use of tinted lenses in competitive sport is well known. Contact lens (CL) integration of wavelength-specific filters may provide significant performance enhancement and visual advantages in baseball compared to tinted spectacles.

Methods: Five wavelength-specific filters were tested and two were chosen for use by the Pacific University 2003 baseball team. Twenty collegiate baseball players were fitted with both SportSight™ Amber42 and Amber66 soft contact lenses for wear during practices and games for a full season. The performance of the study participants was evaluated by comparing batting average, slugging percentage, on base percentage, and fielding percentage. Pitching performance was evaluated by comparing earned runs on average per nine innings, walk to strikeout ratio, hits allowed per inning, and accuracy. Performance statistics were compared under two tinted CL conditions and one no tint condition.

Results: There were no statistically significant differences in any of the performance measures evaluated in this study. However, there was a trend for most athletes to perform better while wearing a SportSight tinted CLs versus wearing no tint. Subjective results also revealed perceived visual and performance benefits to wearing SportSight tinted CLs.

Conclusion: Overall baseball batting, fielding, and pitching performance showed a tendency to improve when athletes wear SportSight tinted CLs. While the results are not statistically significant, any actual or perceived improvement in visual performance and psychological “edge” can make a considerable difference in an athlete or team’s performance. Therefore the SportSight CLs may be beneficial to baseball players.

Key Words: SportSight™, baseball, performance enhancement, contact lenses, tinted lenses, colored filters

Introduction

Tinted eyewear can reduce undesirable glare and illumination, protect the eyes from potentially harmful radiation, and increase color contrast discrimination.^{1,2} Spectacles have traditionally been used to provide tints for sports, driving, occupational and recreational tasks. Tinted contact lenses may provide significant advantages over tinted spectacles for use in some sports.³⁻⁵

MacEwen states, "...it is clear that any person who plays sport out of doors has an increased risk of light damage as there is increased exposure to solar radiation."⁶ On a bright sunny day, illuminance ranges from 1,000 to 10,000 foot-lamberts, which saturates the retina and reduces finer levels of contrast sensitivity.⁷ Dark sunglasses aid in recovery of contrast sensitivity and dark adaptation following photoreceptor saturation.⁸

Sunglasses can protect the eye from potentially harmful portions of the electromagnetic spectrum relative to premature aging of the eye.^{6,9-15} Protective coatings and dyes designed to filter harmful ultraviolet (UV) light are common in the ophthalmic market. UV radiation below 380 nm has been shown to cause damage to the cornea, uvea, lens, and retina.⁷

A potential eye health risk has also been related to long-term exposure to the short-wavelength, high-energy area of the visible spectrum. The "Blue Light Hazard" is speculated to damage the cones of the macular region of the retina.¹¹ Studies have shown deleterious effects from chronic exposure to blue light produced by man-made sources, such as visible light curing units in dentistry, indirect ophthalmoscopy, and biomicroscopy.^{6,15,16} The short wavelength components of direct sunlight are assumed to produce similar effects.

Although research regarding the "Blue Light Hazard" is not conclusive, there is a growing consensus among vision care experts that filtration of blue light is in the best interest of the general public.¹² Reme et al., citing various studies and recommendations issued by major visual health organizations in the United States, state that sunglasses should protect against both UV and blue light.¹⁵ Concern regarding the "Blue Light Hazard" motivated the sunglass manufacturing industry to introduce products that filter short wavelengths, such as Blue Blockers, NoIR Amber, the Corning 550 series, and the Varnet 4006.⁹ Likewise, the "Blue Light Hazard" is addressed in standards for safety eyewear.¹⁷

Wavelength-specific filters also have been recommended for the enhancement of athletic performance. For example, skiers and target shooters typically use amber, rose, gray, and yellow

filters.¹⁸⁻²⁰ Yellow filters have been shown to improve depth perception, contour recognition, and reaction times.^{2,18,21-26}

Although athletes may benefit from a tint, many are unwilling to wear spectacles due to problems with comfort or performance. Despite the benefits provided by sunglasses, 62% of optometrists surveyed feel that there are inherent disadvantages with the use of current non-prescription sunglasses in sports.²⁷ Disadvantages associated with spectacle lenses include peripheral lens distortion, lens edge image doubling or scotoma, restricted or reduced field of view, peripheral light leakage, lens surface reflections, scratching of the lens, and moisture or debris accumulation.²⁸ Disadvantages associated with spectacle frames include discomfort, storage, cosmetic appearance, and maintenance of the eyewear on head. Therefore, spectacles are not conducive to many sports and recreational activities.

Research comparing the visual performance of contact lenses (CLs) to spectacles is limited. Schnider et al. compared visual performance between spectacle and CL wear. With the Pacific Sports Visual Performance Profile™:

Subjects found clear contact lenses to be superior to clear spectacles in issues related to glare, peripheral vision and likelihood of displacement with strenuous activity. Patient perceptions indicated that there may be important psychological advantages to wearing contact lenses for leisure and/or sporting activities.²⁹

Reichow et al. found that CLs are the preferred modality for refractive error correction for athletes because they remove most of the disadvantages of spectacle use in sports.²⁷ Of the optometrists surveyed, 97% preferred CLs to spectacles for patients who are athletes. Likewise, Certified Athletic Trainers (CATs) reported that 95% of NCAA Division IA athletes, 65% of Division III athletes, and 89% of professional athletes requiring vision correction wear CLs. In addition, most optometrists and CATs expressed interest in performance-tinted CLs for their athletes. Performance tints previously have been incorporated into CLs for use in certain sports. By moving the tint from the spectacle plane to the corneal plane, the numerous benefits of tinted spectacles are combined with the advantages inherent with CL wear.^{3,4,28,30,31} Former homerun champion Mark McGwire reported increased peripheral vision and glare reduction, as well as clearer and crisper vision while wearing amber tinted CLs.³² Suntacts™ is a green tinted contact lens designed for surfers.³³ The manufacturer of this product claims generalization to other sports, such as baseball and golf. Prosoft™ is a teal tinted CL that claims to provide a visual

performance edge for tennis players.³⁴ However, there are no published studies confirming the efficacy of either Suntacts™ or Prosoft™ for performance enhancement.

SportSight CL customized tints are designed to reduce glare and brightness throughout the full visual field. SportsSight technology began as a gray tint with a 20% visible light transmission (VLT) in a gas permeable contact lens.³⁵ Subsequent research investigated gray, yellow, and amber tinted SportSight soft CLs and these lenses provide visual benefits equal to or better than clear CLs and transmittance-matched spectacles.^{4,28-32,36} The tints enhance certain aspects of subjective and objective visual performance and improve contrast recognition by filtering short-wavelength light in the visible spectrum and manipulating transmission of wavelengths above 500 nm.¹²

Recent research has investigated the effects of tinted CLs on visual performance. SportSight CL wearers were found to have significantly larger visual fields in all primary meridians, as well as larger binocular fields, compared to tinted spectacle wearers.²⁸ In addition, the “Physiological Photochromic Effect” has been identified by larger changes in pupil size and area with SportSight CLs, relative to spectacles with an equivalent tint, when transitioning from bright to dim environmental conditions.³⁶ Furthermore, SportSight CL wearers were found to exhibit increased low-contrast visual acuity with less measured facial tension, or stress, in bright outdoor conditions than clear CL and tinted spectacle wearers.³¹ In addition to these objectively measured advantages, subjective responses demonstrated that SportSight CLs afforded significantly reduced image degradation, superior comfort in bright indoor and outdoor conditions, and better perceived aspects of visual performance on certain visual tasks.³⁰⁻³²

Based on the clinical and subjective advantages discussed above, a previous study assessed the potential benefits of yellow tinted SportSight CLs on batting and fielding in collegiate baseball.⁴ The aspects of visual performance have been tested on Pacific University’s NCAA Division III baseball team. In 2001, four habitual CL wearers wore clear CLs in the first half of the season and SportSight yellow CLs (approximately 70% VLT) for the second half of the season. The results showed a greater overall improvement in batting performance with the SportSight CLs compared to clear CLs and compared to the rest of the team, although the sample size was too small for the results to be statistically significant. Improvement in fielding was equal between the two groups.

A second-phase study (Phase II) was conducted during the 2002 baseball season and included 24 athletes who wore either of two tints of SportSight CLs in practice and games during the season.⁵ The two tints used were yellow (VLT 45%) for twilight/heavy overcast and amber (VLT 37%) for bright daylight conditions. Players were divided into three groups: the top three athletes as determined by batting average, who did not wear SportSight CLs during games; athletes who wore SportSight CLs during games; and the rest of the team who did not wear SportSight CLs during games. As might be expected, results showed that there were significant differences in batting and fielding performance between the top three athletes and the remaining players who did not wear SportSight CLs. However, there were no statistically significant differences in these measures when the SportSight CL wearers were compared to the top three players.

The results of these two studies suggest that wearing SportSight CLs yield performance enhancement benefits in baseball.^{4,5} Nonetheless, Phase II subjective findings indicated that the tints needed to be modified: increased VLT for the bright-condition tint; and altered spectral characteristics for the overcast-condition tint. The current study was designed to determine specific tints to enhance performance for most players under the varying light conditions encountered in baseball.

Methods

Tint Selection Process

For the tint selection process, the researchers and research assistants evaluated CLs of varying VLT and spectral properties. About half of the experimenters had dark colored irides, and the remainder had light colored irides.

The initial test tints were based upon the exit interview results and CLs used in the Phase II study. Field tests were performed under bright, overcast, and night time artificial lighting, and the test subjects provided subjective data on preference of yellow (69% VLT) and amber (37%, 51%, 64% and 72% VLT). The subjects were asked to evaluate the relative ease with which they could see the seams of a moving baseball; the visibility of the ball against the grass and infield in direct lighting and in shadow; and the reduction of glare from sunlight and artificial lighting.

The experimenters chose amber over yellow in all conditions. For bright conditions, subjects consistently responded that amber 37% VLT was too dark and 51% VLT was too bright. For heavy overcast and night time (artificial lighting) conditions, amber 64% VLT was too dark and 72% VLT was too bright. Based on these results, the SportSight tints selected for this study were amber 42% VLT (Amber42) for bright conditions and amber 66% VLT (Amber66) for heavy overcast and night time conditions.

Subjects

An Institutional Review Board proposal for use of human subjects in research was submitted and approved. Volunteer subjects were recruited from the Pacific University NCAA Division III baseball team and all signed informed consent to participate in the study. Each athlete received a comprehensive vision exam and CL fitting at the Pacific University Family Vision Center prior to beginning the 2003 baseball season. Standard soft CL fitting guidelines were followed.³⁷ To participate in the study, each subject had best-corrected monocular distance Snellen visual acuity of 20/20 or better and no known ocular health disorders.

Twenty athletes, aged 18 to 22 (mean age 21.5 years), volunteered and met the requirements for participation. All subjects were fit with Amber42 and Amber66 SportSight CLs. All subjects received complimentary CL materials and related services for the duration of the study.

Materials

CLs: Paragon Vision Sciences supplied Acuvue 2, Acuvue 2 Toric, Cooper Preference and Preference Toric, and Ciba Focus 1-2 week CLs in custom Amber42 and Amber66 tints. The tinted lenses filtered a minimum of 99% of UVA and UVB, and a substantial amount of blue light from 380 to 500 nm. Each player was fit with the optimal lens based on refractive error and the fit characteristics of the CL. Subjects who required no refractive correction were fit with Ciba 1-2 week plano CLs.

Subjects were provided one pair each of Amber42 and Amber66 CLs for use during baseball practices and games only. Contact lenses were replaced as needed. One set of replacement lenses with each tint were supplied and stored in a trainer's kit.

Players who did not wear any CLs, or who wore only their habitual clear CLs, during games were defined as the "no tint" group for data analysis purposes.

Care Regimen: Subjects were provided Opti-Free Express No Rub contact lens solution and were instructed and trained on proper care and handling techniques. Despite the "no rub" endorsement, instruction included digital massage of the contact lens to maximize cleaning. Insertion and removal techniques were reviewed and practiced with all subjects when the lenses were dispensed.

Data Collection

One athlete documented after each game weather conditions, time of day, lighting, and tint worn by each athlete during the 39-game season. Complete performance statistics concerning batting, fielding, and pitching were maintained by the coaching staff.

Subjective Questionnaires

An exit questionnaire was completed by all athletes at the conclusion of the season, regardless of whether or not they wore the SportSight CLs during games (see Appendix A).

Results

Prior to this study, 7 of 20 athletes had worn CLs. Twelve of the athletes participated in the 2002 SportSight Phase II study. All of the athletes wore the SportSight CLs for at least a part of the 2003 season during practice and/or games. The top three athletes, who are all emmetropic, ceased participation one month into the baseball season due to lack of perceived benefit of the SportSight CLs. One athlete did not perceive a substantial benefit from the tint and the other two felt their depth perception was altered while wearing the SportSight CLs. This perception is contrary to Kinney's findings for yellow tinted ski goggles.²² One athlete also stated that the lenses were advantageous for fielding but not for batting.

Nonetheless, all players' responses were included in the subjective questionnaire results. Data analyses were based on the four non-pitchers and six pitchers who met the SportSight wearing criteria during games (see below).

Batting and Fielding

Criteria for inclusion in the comparison of batting and fielding statistics were a minimum of two game appearances and a minimum of six plate appearances (sum of at bats, walks, hit by pitch, and sacrifice flies). Table 1 shows the batting and fielding statistics for the 2003 season based on these criteria. Statistics include batting average, slugging percentage, on-base percentage, and fielding percentage. Although on-base percentage includes walks and errors committed by the opposing team, rather than solely hitting performance by player, it is a recognized and valid indicator of the level of play.

The results are reported separately for the top three athletes, as determined by batting average, who did not wear SportSight CLs during games, and the remaining nine athletes who met the analysis criteria. Chi-square analyses were conducted by comparing the no tint data to the combination of Amber42 and Amber66 data for these nine athletes. The results show that there are no statistically significant differences ($p > 0.05$) for any of the performance statistics.

Table 1. Comparison of batting and fielding statistics for 2003.

	Top 3 Athletes	Remaining 9 Athletes			χ^2	p value
	No Tint	No Tint	SportSight Amber42	SportSight Amber66		
Total Plate Appearances	499	370	114	157		
Batting Average	.349	.296	.231	.294	1.00	0.670
Slugging Percentage	.615	.377	.288	.360	1.33	0.513
On Base Percentage	.413	.378	.289	.382	0.00	0.998
Fielding Percentage	.967	.946	.947	.953	0.00	0.998

Of the nine, four athletes met the criteria for inclusion in two or more of the specific tint conditions of Amber42, Amber66, or no tint. The statistics for the tint conditions are shown in Figures 1-4 below. Figure 1 shows batting averages, Figure 2 shows slugging percentages, Figure 3 shows on base percentages, and Figure 4 shows fielding percentages.

Figure 1. Batting average comparison of four athletes with and without the SportSight tinted CLs. Data are shown for athletes playing in at least two games and having a minimum of six plate appearances; missing data points indicate the athlete did not meet the inclusion criteria under these specific conditions.

Batting Average of Four Individual Athletes

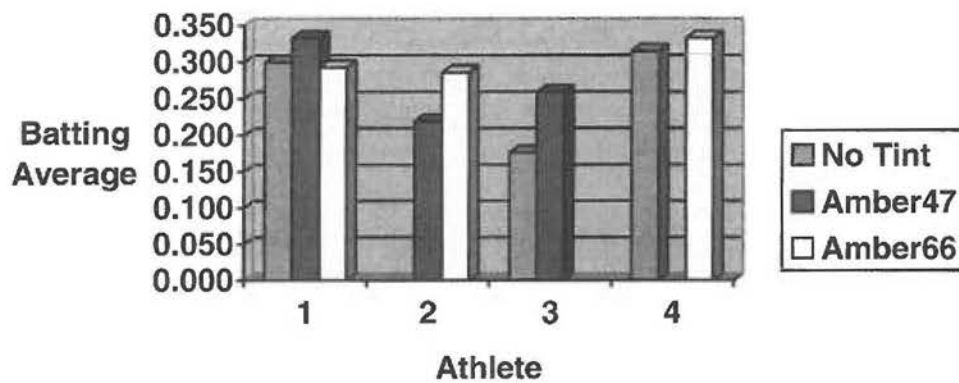


Figure 2. Slugging percentage comparison of four athletes with and without the SportSight tinted CLs. Data are shown for athletes playing in at least two games and having a minimum of six plate appearances; missing data points indicate the athlete did not meet the inclusion criteria under these specific conditions.

Slugging Percentage of Four Individual Athletes

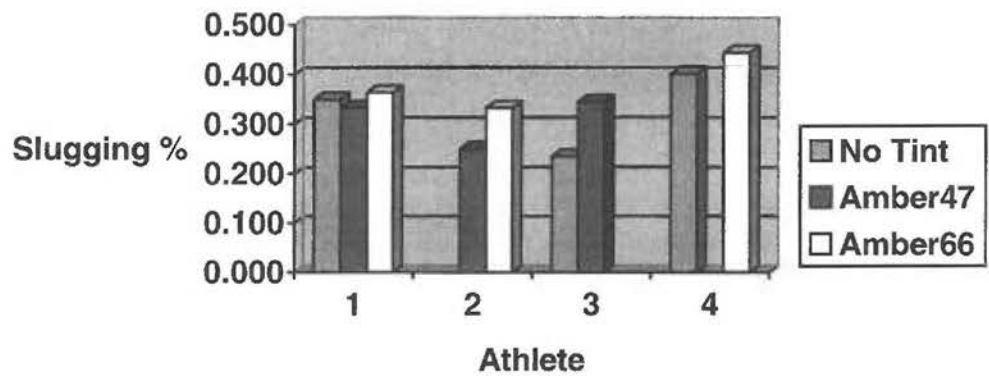


Figure 3. On base percentage comparison of four athletes with and without the SportSight tinted CLs. Data are shown for athletes playing in at least two games and having a minimum of six plate appearances; missing data points indicate the athlete did not meet the inclusion criteria under these specific conditions.

On Base % of Four Individual Athletes

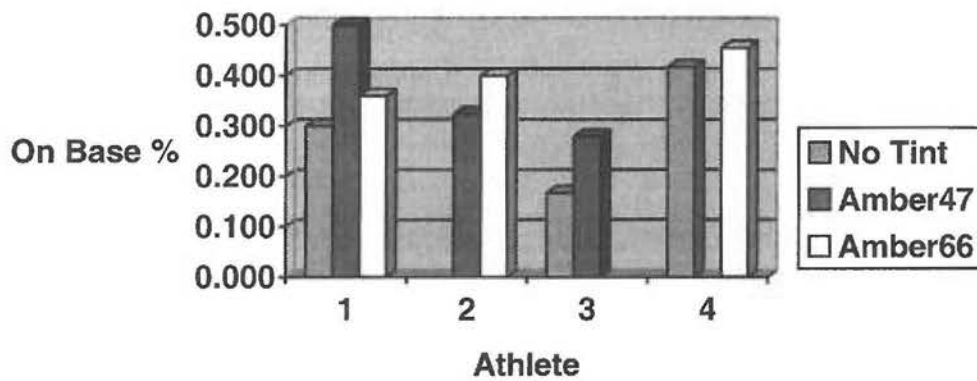
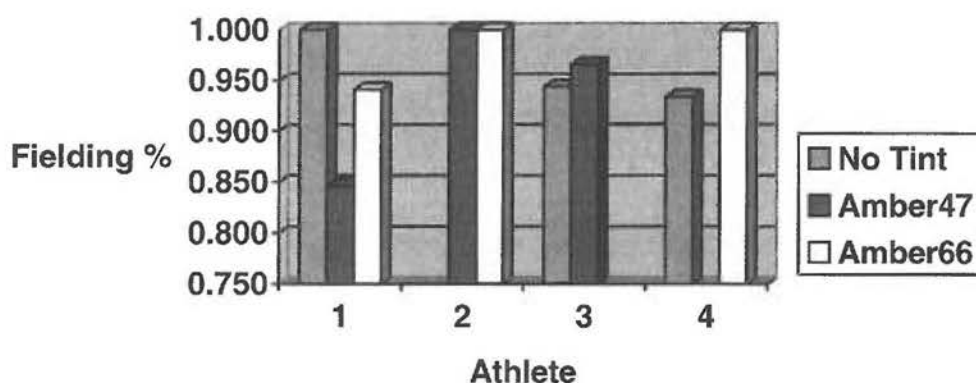


Figure 4. Fielding percentage comparison of four athletes with and without the SportSight tinted CLs. Data are shown for athletes playing in at least two games and having a minimum of six plate appearances; missing data points indicate the athlete did not meet the inclusion criteria under these specific conditions.

Fielding % of Four Individual Athletes



Pitching

Criteria for inclusion in the comparison of pitching statistics were a minimum of two games pitched and a minimum of four innings pitched. Table 3 shows the pitching statistics for the 2003 season. These include earned runs on average per nine innings; walk to strikeout ratio; hits allowed per inning; and accuracy, or the sum of wild pitches, balks, and hit batters, per inning. The team was divided as wearing no tint, Amber42, or Amber66. Chi-square analyses were conducted comparing the no tint data to the combined Amber42 and Amber66 data. The results show that there are no statistically significant differences ($p > 0.05$) for any of the performance statistics.

Table 2. Comparison of pitching statistics for 2003. Category A = one pitcher who met the pitching criteria for only Amber42 and Amber66. Category B = two pitchers who met the pitching criteria for only Amber42 and no tint. Category C = three pitchers who met the pitching criteria for only no tint.

	Category A		Category B		Category C	χ^2	p value
	Amber42	Amber66	Amber42	No tint	No tint		
Total Innings Pitched	20.33	52	17.67	24.67	126.33		
Earned Run Average	3.54	3.64	3.63	5.84	4.84	1.86	0.173
Walk to Strike Out Ratio	0.615	0.528	0.566	0.769	0.733	1.07	0.301
Hits per Inning	0.836	0.942	0.980	1.582	1.187	2.06	0.107
Accuracy	0.295	0.289	0.346	0.203	0.206	1.70	0.193

Subjective Questionnaires

Every athlete who initially participated in the study answered a subjective questionnaire (see Appendix A) at the end of the season. The most frequently encountered comments noted that the seams on the ball seemed to stand out against the background, it was easier to pick up visually, and it was easier to see coming off the bat.

Changing weather conditions contributed to some negative aspects of wearing the Amber42 CLs on otherwise bright days, probably because they transmitted less light when the weather turned cloudy.

Table 3. Results of subjective questionnaire. All results were not statistically significant ($p>0.05$).

	BRIGHT CONDITIONS	CLOUDY/OVERCAST CONDITIONS	NIGHT CONDITIONS
Preferred CL tint for the specified condition	Amber42 & Amber66 preferred equally over no tint	Amber66	Amber42 (note: 1 response)
Improved batting performance	Neutral	Neutral	Neutral
Improved ability to see ball while batting	Agree/Neutral	Neutral	Neutral
Improved fielding performance	Agree	Agree	Neutral
Improved ability to see ball while fielding	Agree	Neutral	Neutral
Improved pitching ability (pitchers only)	Agree/strongly agree	Agree	N/A

Discussion

The Pacific University baseball team has participated in three consecutive studies to determine the effectiveness of the SportSight CLs on baseball performance. Some of the athletes participated in all three studies to date, thus providing valuable subjective feedback on the effectiveness of the SportSight tints. Modifications to the SportSight tints for the current study were based on recommendations of previous research. The purpose of this study was to determine the effects of the modified SportSight tints of Amber42 and Amber66 on baseball performance under variable environmental conditions.

The results of the data are not statistically significant due to the small sample size. Therefore the value is in the trends apparent in the data. Although there was not a significant difference in statistics, subjectively the athletes believed the SportSight CLs improved fielding performance in both bright and heavy overcast conditions. Responses also indicate that the SportSight tints did not provide a noticeable effect on batting performance. Interestingly, pitchers noticed the greatest effect from the SportSight tints. They particularly noticed that the setting seemed clearer and it was easier to see communication from the catcher. It is the impression of one of the advisors, Head Baseball Coach Greg Bradley, that an individual's performance improvement of 0.050 or more on any of these statistics is substantial.

Team results show that batting and fielding performance were not statistically impacted from wearing either SportSight tint. However, there was a trend for individuals to show improved performance with the SportSight CLs. Pitching performance followed a similar pattern. Although there was not a statistically significant difference, the trend showed improved performance in earned run average, walk to strikeout ratio, and hits allowed per inning while wearing the SportSight CLs. Once again, it is Coach Bradley's impression that a reduction in

earned run average of 0.75 or more is substantial. It was observed that all pitchers who wore the SportSight CLs while pitching, pitched more innings per game while wearing the tinted CLs verses wearing no tint. The improvement in pitching statistics and the greater number of innings pitched suggest an enhancement of pitching performance, which warrants further investigation.

Future research should expand the number of baseball players participating, should further investigate the current tint for bright conditions as amenable to changing weather conditions, and investigate the possible effects on depth perception.

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References

- ¹ Chung STL, Pease PL. Effect of yellow filters on pupil size. *Optom Vis Sci* 1999; 76:59-62.
- ² Lee JE, Stein JJ, Prevor MB, Seiple WH, Holopigian K, Greenstein VC, Stenson SM. Effect of variable tinted spectacle lenses on visual performance in controlled subjects. *CLAO J* 2002; 28: 80-82.
- ³ Banta A, Berry C, Lum S, Oliver R, Reichow AW, Citek K. Comparative Study of Visual Performance With Tinted Soft Contact Lenses vs. Clear Soft Contact Lenses and Tinted Spectacles Under Bright Outdoor Conditions; Phase II. Unpublished doctoral thesis, Pacific University College of Optometry, 2003.
- ⁴ Banta A, Berry C, Lum S, Oliver R, Reichow AW, Citek K. A Study Investigating A Season's Baseball Performance While Wearing SportSight™ Soft Contact Lenses. Unpublished doctoral thesis, Pacific University College of Optometry, 2003.
- ⁵ Schroder J, Richardson M, LeBreton R, Reichow AW, Citek K, Erickson G, Bradley G, Broadbent K. A Study Investigating A Season's Baseball Performance While Wearing SportSight Soft Contact Lenses: Phase II. Unpublished doctoral thesis, Pacific University College of Optometry, 2003.
- ⁶ MacEwen CJ. Light and lighting: light damage and the eye. In: Loran DFC, MacEwen CJ. *Sports Vision*. Oxford: Butterworth-Heinemann 1995: 103-112.
- ⁷ Michaels, D. *Visual Optics and Refraction: A Clinical Approach*. Third edition, Mosby 1985: 12-13.
- ⁸ Clark BA. Color in sunglass lenses. *Am J Optom*. 1969;46:875-80.
- ⁹ Etzel R, Balk SJ, Bearer CF, Miller MD et. al. Ultraviolet light: a hazard to children. *Pediatrics* 1999; Aug.; 104 (2); 328-333.
- ¹⁰ Pitts DG. Sunglasses for ocular protection. In: Pitts DG, Kleinstejn RN. *Environmental Vision – Interactions of the Eye, Vision, and the Environment*. Boston: Butterworth-Heinemann, 1993: 309.
- ¹¹ Richer S. Is there a prevention and treatment strategy for macular degeneration? *J Am Optom Assoc* 1993; 64: 838-850.
- ¹² Reichow AW. Light architecture™ technology: The science behind SportSight™ GP. Paragon Vision Sciences, Inc. Product Collateral, 2000.
- ¹³ Ham WT, Jr. Ocular hazards of light sources: Review of current knowledge. *J Occup Med* 1983; 25(2): 101-103.
- ¹⁴ Koide R, Ueda TN, Dawson WW, Hope GM, Ellis A, Somuelsen D, Ueda T, Iwabuchi S, Fukuda S, Matsuishi M, Yasuhara H, Ozawa T, Armstrong D. [Retinal hazard from blue light emitting diode.] *Nippon Ganka Gakkai Zasshi* 2001 Oct; 105 (10): 687-695.
- ¹⁵ Bradnam MS, Montgomery DM, Mosley H, Dutton GN. Quantitative assessment of the blue-light hazard during indirect ophthalmoscopy and the increase in the "safe" operating period achieved using a yellow lens. *Ophthalmology* 1995; 102(5): 799-804.
- ¹⁶ Reme C, Reinboth J, Clausen M, Hafezi F. Light damage revisited: converging evidence, diverging views? *Graef's Arch Clin Exp Ophthalmol* 1996; 234: 2-11.
- ¹⁷ ANSI Z87.1-2003, American national standard occupational and educational personal eye and face protection devices. New York: American National Standards Institute, 2003.
- ¹⁸ Yap M. The effect of a yellow filter on contrast sensitivity. *Ophthalmol Physiol Opt* 1984; 4: 227-232.
- ¹⁹ Glenn L, Zink D, Dupree D, Reichow AW, Samson T. Vision and Performance Enhancement With Ski Goggle Tints. Unpublished doctoral thesis, Pacific University College of Optometry, 1996.
- ²⁰ Classe J. *Optometry Clinics: Volume3, Number 1 Sports Vision*. Norwalk, CT: Appleton and Lange, 1993: 115.
- ²¹ Kinney JAS, Schlichting CL, Neri DF, Kindness SW. Reaction time to spatial frequencies using yellow and luminance-matched neutral goggles. *Am J Optom Physiol Opt* 1983; 60: 132-138.
- ²² Kinney JAS, Luria SM, Schlichting CL, Neri DF. The perception of depth contours with yellow goggles. *Perception* 1983; 12: 363-366.
- ²³ Corth R. The perception of depth contours with yellow goggles – An alternative explanation. *Perception* 1985; 14: 377-378.
- ²⁴ Kinney JAS. The perception of depth contours with yellow goggles – comments on letter by Richard Corth. *Perception* 1985; 14: 378-379.
- ²⁵ Kelly SA. Effect of yellow-tinted lenses on brightness. *J Opt Soc Am A* 1990; A7: 1905-1911.
- ²⁶ Rabin J, Wiley R. Differences in apparent contrast in yellow and white light. *Ophthalm Physiol Opt* 1996; 16: 68-72.
- ²⁷ Reichow AW, Fredlund KM, Treick KD, Whitehouse KD, Carmiencke KL. Optometric trends in sports vision: A two decade review. *Optometry: J Am Optom Assoc*; Submitted for publication.

- ²⁸ Elliot A, Reisler E, Chin B, Reichow AW, Citek K, Caroline P. Comparative study of visual performance with tinted soft contact lenses vs. clear soft contact lenses and tinted spectacle lenses under bright and dim indoor conditions. Unpublished doctoral thesis, Pacific University College of Optometry, 1999.
- ²⁹ Schnider CM, Coffey BM, Reichow AW. Comparison of sports-oriented visual performance with spectacles vs. contact lenses. Paper presentation, European Research Symposium, Geneva, Switzerland, 1991.
- ³⁰ Geis T, Johns H, Perea S, Rossman A, Ebeler A, Phillips L, Sifferman L, Reichow A, Citek K, Caroline P. Comparative study of visual performance with tinted GP contact lenses vs. clear GP contact lenses and tinted spectacle lenses under bright and dim indoor conditions. Unpublished doctoral thesis, Pacific University College of Optometry, 1999.
- ³¹ Waddell J, Hashimoto L, Broecker E, Reichow AW, Citek K. Comparative study of visual performance with SportSight™ soft contact lenses vs. clear soft contact lenses and tinted spectacle lenses under bright outdoor conditions; Phase I. Unpublished doctoral thesis, Pacific University College of Optometry, 2002.
- ³² Kopp JD. Eye on the ball: an interview with Dr. C. Stephen Johnson and Mark McGwire. *J Am Optom Assoc* 1999; 70(2): 79-84.
- ³³ Petersen WL. Contact Lenses and Surfing: The need to ensure safety in the sport has prompted some interesting studies. *Contact Lens Spectrum*. April 1989; 159: 59-60
- ³⁴ When the ball stands out your play stands out. http://www.aclens.com/prosoft_info.asp.
- ³⁵ Elliot A, Reisler E, Chin B, Reichow AW, Citek K, Caroline P. A Visual Performance Comparison of SportSight GP and tinted Spectacle Modalities. Unpublished doctoral thesis, Pacific University College of Optometry, 2000.
- ³⁶ Kikuchi J, Lusk M, Russell J, Reichow A, Citek K, Caroline P. A Visual Performance Comparison of SportSight™ Soft Contact Lenses and Tinted Spectacle Modalities. Unpublished doctoral thesis, Pacific University College of Optometry, 1999.
- ³⁷ Veys J, Meyler J, Davies I. *Essential Contact Lens Practice*. Oxford: Butterworth-Heinemann, 2002: 32.

Appendix A: Exit Survey

Date: 2003 Baseball Season: Pacific University Athletics

To: 2003 Pacific University Baseball Team

Re: **SportSight Tinted Contact Lens Baseball Study Exit Survey**

From: Coach Greg Bradley, Coach Kent Broadbent,
Dr. Alan Reichow, Dr. Graham Erickson, Dr. Karl Citek,
SportSight Research Team: Tara Peterson, Kyle Smith, Jared Pearson

Attached is a survey regarding the SportSight Contact Lens project conducted with your baseball team. Whether or not you wore the lenses, your responses are critical to the results of the project. Please complete the enclosed survey. If you have any questions, please do not hesitate to ask.

Thank you for your feed back. All of your responses are completely confidential and you will not be identified in any reports or summaries.

Name: _____
Date: _____
Date of birth: _____
Eye color: _____

Please circle your response (Y=yes, N=no, or on the scale of 1 to 5) and write in comments.

1. Did you wear CONTACT LENSES routinely prior to the study? Y
N

2. Have you worn SUNGLASSES for baseball in the past? Y
N

a. If yes:

i. What kind of tint did you wear (list: gray, yellow, other, etc.)?

ii. Did you wear them for batting? Y

N

iii. Did you wear them for fielding? Y

N

iv. Were they beneficial? Y

N

1. Explain how so:

v. If you have worn sunglasses for baseball in the past, were the SportSight contact lenses more beneficial to your performance?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Comments:

The following questions apply to BRIGHT DAY games:

1. Did you wear the SportSight contact lenses for any BRIGHT DAY games? Y N
- a. If YES, which tint did you prefer?
- Bright condition lenses
 - Cloudy/night condition lenses
 - Both
 - Neither
- b. If NO, why not?

2. In your opinion, during *bright day games*, did either of the SportSight contact lenses (bright condition lenses or cloudy/night condition lenses) help to improve your BATTING performance?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

3. In your opinion, during *bright day games*, did either of the SportSight contact lens tints improve your ability to see the baseball while BATTING?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

4. In your opinion, during *bright day games*, did either of the SportSight contact lens tints help to improve your performance in the FIELD?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

5. Did either of the SportSight contact lens tints help to improve your ability to see the baseball while FIELDING during *bright day games*?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

6. PITCHERS only: Did either of the SportSight contact lens tints help to improve your pitching ability during *bright day games*?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

The following questions apply to HEAVY OVERCAST/CLOUDY DAY games:

1. Did you wear the SportSight contact lenses for any HEAVY OVERCAST/CLOUDY DAY games?

Y N

- a. If YES, which tint did you prefer?
1. Bright condition lenses
 2. Cloudy/night condition lenses
 3. Both
 4. Neither

b. If NO, why not?

2. In your opinion, during *heavy overcast/cloudy day games*, did either of the SportSight contact lenses (bright condition lenses or cloudy/night condition lenses) help to improve your BATTING performance?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

3. In your opinion, during *heavy overcast/cloudy day games*, did either of the SportSight contact lens tints improve your ability to see the baseball while BATTING?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

4. In your opinion, during *heavy overcast/cloudy day games*, did either of the SportSight contact lens tints help to improve your performance in the FIELD?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

5. Did either of the SportSight contact lens tints help to improve your ability to see the baseball while FIELDING during *heavy overcast/cloudy day games*?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

6. PITCHERS only: Did either of the SportSight contact lens tints help to improve your pitching ability during *heavy overcast/cloudy day games*?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

The following questions apply to NIGHT games:

1. Did you wear the SportSight contact lenses for any NIGHT games? Y N
- a. If YES, which tint did you prefer?
- 5. Bright condition lenses
 - 6. Cloudy/night condition lenses
 - 7. Both
 - 8. Neither
- b. If NO, why not?

2. In your opinion, during *night games*, did either of the SportSight contact lenses (bright condition lenses or cloudy/night condition lenses) help to improve your BATTING performance?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

3. In your opinion, during *night games*, did either of the SportSight contact lens tints improve your ability to see the baseball while BATTING?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

4. In your opinion, during *night games*, did either of the SportSight contact lens tints help to improve your performance in the FIELD?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

5. Did either of the SportSight contact lens tints help to improve your ability to see the baseball while FIELDING during *night games*?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

6. PITCHERS only: Did either of the SportSight contact lens tints help to improve your pitching ability during *night games*?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

**The following questions apply to THOSE PLAYERS WHO WORE SPORTSIGHT LENSES
ROUTINELY IN GAMES &/OR PRACTICE THROUGHOUT THIS SEASON:**

1. If you wore SportSight contact lenses *routinely in games &/or practice*, and were to play baseball in future seasons, would you want to wear the SportSight contact lenses for baseball practice and games?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

2. If you wore SportSight contact lenses *routinely in games &/or practice*, would you recommend wearing the SportSight contact lenses to teammates or other baseball players?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

3. Were there negative aspects to wearing the SportSight contact lenses during practice and games (If so, please comment below)?

1	2	3	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Please explain:

4. If you wore the SportSight contact lenses in any games and stopped, when did you stop and why?