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Recommended Citation

Banta, Aaron M.; Berry, Christopher J.; Lum, Stephen W.; and Oliver, Randy C., "A study investigating a season's baseball performance while wearing SportSight soft contact lenses" (2002). *College of Optometry*. 1388.

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

Abstract

Background: The use of spectacles with colored lenses in sports is well known. Athletes have worn such colored lenses in an attempt to enhance their performance for a number of years with promising results. The integration of wavelength specific filters into contact lenses may provide significant performance enhancement as well as the visual advantages usually afforded by contact lenses relative to spectacles.

Methods: A small group (N=5) of collegiate baseball players were fitted with SportSight soft contact lenses and were asked to wear them during practices and games for half of a season. The players' batting and fielding statistics from the first and second halves of the season were compared to each other and to those of non-participating team members. All of the subjects were existing soft contact lens wearers.

Results: The test group demonstrated dramatic improvements in batting statistics while wearing the SportSight lenses. Their percentage of statistical improvement in each category far surpassed that of non-participating team members.

Conclusion: The results of this pilot study imply that wearing SportSight soft contact lenses yields marked performance enhancement for baseball players. Future studies involving larger subject pools are warranted to thoroughly evaluate the possible statistical significance of these findings.

Degree Type

Thesis

Degree Name

Master of Science in Vision Science

Committee Chair

Alan W. Reichow

Keywords

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

Subject Categories

Optometry

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**A STUDY INVESTIGATING A SEASON'S BASEBALL
PERFORMANCE WHILE WEARING SPORTSIGHT™
SOFT CONTACT LENSES**

By

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**A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May, 2002**

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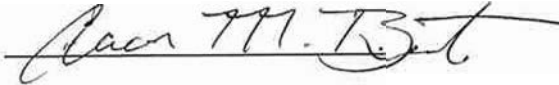
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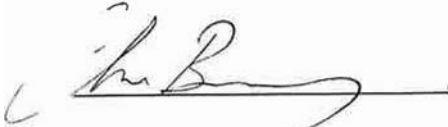
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Biographies of Authors

Aaron M. Banta: Aaron grew up in Richland, Washington. He did his undergraduate studies at the University of Washington from 1995-1999 where he received a Bachelor of Science degree in Zoology. While at Pacific University College of Optometry, Aaron received the Air Force Health Professions Scholarship. Following graduation from PUCO, he will serve three years in the USAF as an optometric physician. Aaron plans to join a private primary care practice after his military obligation is fulfilled. He is currently a member of the Beta Sigma Kappa Optometric Honor Society as well as the Washington Association of Optometric Physicians and the Oregon Optometric Physician's Association.

Christopher J. Berry: Christopher grew up in Albany, Oregon. He attended the University of Oregon where he received a Bachelor of Science degree in History. He is currently a member of Beta Sigma Kappa Optometric Honor Society and the Oregon Optometric Physician's Association. After graduation Christopher looks forward to joining his father's optometry practice in Albany.

Stephen W. Lum: Stephen grew up in Daly City, CA. He graduated from the University of California, at Davis in 1998 with a Bachelor of Science degree in Biological Sciences with emphasis on Neurobiology, Physiology and Behavior. He is currently a member of the Beta Sigma Kappa Optometric Honor Society and plans on returning to California to practice following graduation.

Randy C. Oliver: Randy grew up in Barnwell, Alberta. He attended the University of Alberta from 1995-1999 and received a Bachelor of Sciences degree in Biological Sciences. Following graduation from PUCO, Randy will work for the USAF for three years and then open a private practice.

Abstract

Background: The use of spectacles with colored lenses in sports is well known. Athletes have worn such colored lenses in an attempt to enhance their performance for a number of years with promising results. The integration of wavelength specific filters into contact lenses may provide significant performance enhancement as well as the visual advantages usually afforded by contact lenses relative to spectacles.

Methods: A small group (N=5) of collegiate baseball players were fitted with SportSight™ soft contact lenses and were asked to wear them during practices and games for half of a season. The players' batting and fielding statistics from the first and second halves of the season were compared to each other and to those of non-participating team members. All of the subjects were existing soft contact lens wearers.

Results: The test group demonstrated dramatic improvements in batting statistics while wearing the SportSight™ lenses. Their percentage of statistical improvement in each category far surpassed that of non-participating team members.

Conclusion: The results of this pilot study imply that wearing SportSight™ soft contact lenses yields marked performance enhancement for baseball players. Future studies involving larger subject pools are warranted to thoroughly evaluate the possible statistical significance of these findings.

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

Introduction

With the public's increasing awareness of the potential harmful effects of W radiation, tinted sunglasses have become a popular modality of sun protection. For several decades, sunglass manufacturers have marketed various sun-filtering products including polarized lenses, UV filters, and specialty tints. Although some tints are designed for cosmetics, others are produced with safety and performance enhancement in mind.

W protective coatings and tints are commonplace in the spectacle market and are well known by optometrists and ophthalmologists alike. W radiation between the wavelengths of 200 and 380 nm has been shown to cause damage to the cornea, uvea, lens and retina.' In addition to the threat posed by W radiation, the potential eye health risk related to long-term exposure to the short wavelength end of the visual spectrum has been cause for increasing concern. The so-called "Blue Light Hazard" is speculated to damage the cones of the macular region of the retina. Although the research regarding the Blue Light Hazard is not conclusive, there is growing consensus amongst vision care experts that filtration of the high energy portion of the Visible Light Spectrum (VIS) is in the best interest of the general public.²

Concern regarding the Blue Light Hazard motivated the sunglass manufacturing community to produce products that blocked the short wavelength end of the VIS. Products such as Blu-Blockers, NoIR Amber, the Corning 550 series and the Vaurnet 4006 claimed to do so and became immensely popular in the 1980s.³ The negative effects of chronic exposure to the Blue Light Hazard produced by man-made sources have been recognized.^{3,4}

The relative presence or absence of a Blue Light Hazard relating to normal sunlight exposure is less clear. Exposure to the blue light portion of normal sunlight has been shown to produce solar retinitis and may be related to senile macular degeneration.⁵ In Sports Vision, McEwan states that relative to eye health, "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." He goes on to say that sunglasses should absorb 100% of damaging ultraviolet radiation below 400 nm and that, "there should be low transmission at the blue end of the visible spectrum."⁶ Reme, et. al., citing various studies and

recommendations issued by several of the major visual health organizations in the United States, state that protection against both UV and blue light should be incorporated in to the spectrum of safety considerations for sunglasses.⁷

In addition to the use of wavelength specific filters for ocular health reasons, use of colored filters in athletics for performance enhancement is widespread. Yellow filters are commonly worn by skiers and target shooters, for example. It has been claimed that wearing yellow filters improves depth perception and contour recognition and attempts have been made to explain the possible mechanisms by which such enhancement occurs.^{8,9,10} Though there is a lack of research definitively supporting performance enhancement by color filters, subjective reports from athletes regarding their efficacy is abundant. In particular, Mark McGwire has gone on record discussing the advantages of wearing color tinted contact lenses, citing increased peripheral vision, glare reduction, depth perception, as well as clearer and crisper vision.¹¹

Due to the physical demands of their respective sports, the refractive errors of athletes are more frequently compensated for with contact lenses than with spectacles. In fact, polled athletic trainers indicated that 95% of NCAA Division IA, 65% of Division III and 89% of professional athletes that require vision correction choose to wear contact lenses. This is also the preferred choice of optometrists, as 97% of those polled prefer contact lenses to spectacles for athletes.¹²

Almost two-thirds (62%) of polled optometrists agree that there are inherent disadvantages with current non-prescription sunglasses.¹² Disadvantages of spectacle wear include peripheral lens distortion, lens edge image doubling, restricted or reduced field of view, frame discomfort, etc. These disadvantages often limit the usefulness of sunglasses and cosmetic tints in many sports and recreational activities. In many instances, athletes may benefit from a tint that enhances comfort and visual performance, however, they may not and do not wear them due to problems with fit, stability or safety issues associated with spectacle wear. It is not surprising, therefore, that 93% of optometrists, 63% of NCAA Division IA and 86% of Division III certified athletic trainers and 94% of professional trainers are interested in their athletes using tinted contact lenses for competition. In fact, 100% of professional baseball trainers showed interest in using tinted contact lenses for their athletes.¹² Additionally, recent research

has demonstrated that gray tinted soft contact lenses provide equal or better visual advantages than transmittance-matched spectacles, and offer superior subjective comfort.^{13,14}

Contact lenses eliminate virtually all of the optical deficiencies and physical limitations associated with the use of sunglasses. Through the use of a customized tint, the SportSight CL is designed to reduce glare and brightness throughout the complete visual field in order to enhance comfort and to improve contrast recognition by filtering short-wavelength light in the visible spectrum and manipulating transmission of wavelengths above 500 nm.¹⁵ By moving the tint from the spectacle plane to the corneal plane, SportSight CLs provide the numerous benefits of tinted sunglasses while also producing the advantages inherent with contact lens wear.

Currently, the American National Standards Institute (ANSI) has not yet established specific guidelines for tinted contact lenses. Scientific research comparing the visual performance of tinted contact lenses to tinted spectacles is limited. Schnider, et. al., compared sports oriented visual performance between spectacle and contact lens wearers. They found clear contact lenses to be superior to clear spectacles with regard to glare, peripheral vision and likelihood of displacement with strenuous activity. Additionally, they found that there may be important psychological advantages to wearing contact lenses compared to spectacles for leisure and/or sporting activities.¹⁶ Geis et al. found differences between the transmission characteristics of SCLs and tinted spectacles and determined the ideal visible light transmission levels for SportSight lenses.¹⁷

Since that time, numerous research projects involving SportSight lenses have been conducted to investigate their effects on visual performance. All of these studies compared SportSight tinted contact lenses to transmission-matched spectacles and clear contact lenses. SportSight wearers were found to have significantly larger visual fields in all primary meridians as well as larger binocular fields than tinted spectacle wearers. Additionally, the "Physiological Photochromic Effect" of SportSight lenses was identified. This effect was shown to provide SportSight wearers with unique advantages in various lighting environments over clear contact lenses and tinted spectacles.¹⁸ Furthermore, SportSight wearers were found to exhibit superior low-contrast visual acuity with less measured facial tension (stress) in bright outdoor conditions than clear

contact lens and tinted spectacle wearers.¹⁴ In addition to the aforementioned objectively measured advantages, subjective responses demonstrated that SportSight lenses afforded significantly better subjective visual performance on numerous visual tasks,^{18,19} reduced image degradation^{14,18,19} and superior subjective comfort in bright outdoor conditions.^{14,18,19}

The potential ramifications of combining the known advantages of contact lenses over spectacles with the proposed performance enhancement of colored tints are substantial. However, the current study focuses exclusively on the sport of baseball. Despite the previously mentioned disadvantages of spectacle wear, baseball trainers indicate that almost two-thirds (62%) of professional baseball players use sunglasses during competition. Players state the main reason for doing so is to improve performance, followed by protection, endorsement, and cosmetic reasons.¹² The purpose of the current pilot study was to investigate the effects of a custom designed yellow tinted soft contact lens wear upon baseball performance. We hypothesized that enhancement of visual performance resulting from such a lens would lead to improved batting and fielding statistics for collegiate baseball players.

Methods

Subjects

Volunteer subjects were solicited from the Pacific University Varsity Baseball Team. The subjects received comprehensive vision exams and contact lens fittings at the Pacific University Family Vision Center prior to beginning the study. Requirements for inclusion in the study were:

- current spherical soft contact lens (CL) wearer
CL corrected 6m Snellen Visual Acuity of 20/20 or better OD, OS, OU
- no history of ocular health disorders

Five subjects volunteered and met the requirements. The subjects were fit with two sets of lenses: 1) clear Acuvue 2 CLs with Visitint and 2) custom tinted Acuvue 2 CL's. The subjects were all male and their ages ranged from 20 to 23, with a mean age of 21.75.

None of the subjects received financial compensation for participating in the study. The baseball team received \$400 for facilitating player participation.

Materials

Clear Soft Contact Lenses: Paragon Vision Sciences supplied clear spherical Vistakon Acuvue 2 lenses for each of the subjects. The clear lenses contained the standard Acuvue 2 Visitint. The clear lenses had 89% visible light transmission (VLT).

SportSight Tinted Soft Contact Lenses: Paragon Vision Sciences supplied custom tinted Vistakon Acuvue 2 lenses based on spectral transmission data formulated by previous research. The yellow tint used in the current study was designed to enhance the visibility of a white baseball. The tint selectively filters the short wavelength end of visible light as well as UV radiation. In addition, the tint filters a minimum of 99% of UVA and UVB light. At least 77% of blue light from 380 to 500 nm is removed by the SportSight tint.

Care Regimen

Subjects were given bottles of Renu solution to clean and store their CL's and instructed on proper care and handling of the CL's. Subjects were given one pair of tinted CL's at a time, for use in games and practice. The tinted CL's were replaced every two weeks.

Procedure

Each subject received a comprehensive vision exam from the Pacific University Family Vision Center before the beginning of the baseball season. The subjects were fit with spherical Acuvue 2 CL's and provided with six pair of clear lenses with instructions to replace the lenses every two weeks. Subjects wore the clear CLs for the first half of the season, 19 games over 27 days. Subjects were prescribed four pair of tinted lenses to be worn for the second half of the season, 20 games over 37 days. Subjects were given one pair of tinted CLs at a time and exchanged worn lenses for new lenses through the head baseball coach. Subjects were instructed to wear the tinted CLs for baseball use only (i.e. practice and games). Subjects were given a questionnaire to fill out after the first practice

with the tinted CL's, and again at the end of the season (see Appendix A). An expanded questionnaire was also administered at the end of the season (see Appendix B)

Results

One of the five original subjects withdrew from the study after wearing the tinted lenses for 1 game. This subject reported difficulty seeing the ball under the bright sunny conditions of that game. The remaining four subjects completed the study according to the original wearing schedule. The subject who withdrew from the study is identified as Player 5 in Tables I-III and his results were not averaged with those of the other four players. Objective results were collected by analyzing final statistics for the baseball season. First half statistics were compared to second half statistics for each player in the study as well as the rest of the team.

Marked improvement was seen in all batting performance categories for the 4 players in aggregate while wearing the SportSight CLs (see Table I). The improvement seen by the group wearing the tinted CLs was greater than the improvement seen by the rest of the team during the same time period. Comparing second half to first half season statistics (see Table II), the tinted SCL group improved their batting average by 30%, slugging average by 23% and on-base percentage by 27%, while the rest of the team improved their averages by 14%, 5% and 10%, respectively. In a separate statistical category, a comparison of walks to strikeouts was represented by a ratio. The ratio was created by dividing total number of walks by total number of strikeouts. A higher ratio indicates better performance. The tinted SCL group improved the walk/strikeout ratio by 75.6%, while the rest of the team showed a decline of 0.1%. The players wearing the tinted CLs showed an equal improvement in fielding percentage with the rest of the team, comparing 1st half to 2nd half fielding statistics.

Performance questionnaires were administered to determine the perceived benefits of the tinted CL's for baseball. After wearing the lenses for one baseball practice the four participants either agreed or strongly agreed that the SportSight CLs reduced the brightness of the sunlight on the field making it easier to see. Three of the participants indicated that the SportSight CL improved their general ability to see the baseball, and one participant was neutral with regard to this question. In general the participants were

neutral in reporting any improvement with their ability to see the seams of the baseball during batting practice and improved depth perception. At the end of the season the same questionnaire was given and the participants in general agreed that the ability to see the baseball improved with the SportSight SCLs.

Discussion

Previous research conducted in clinical and laboratory settings suggested that custom tints can be incorporated into CL's to improve visual performance and to increase comfort for the wearer. The current study is a pilot study that investigates the potential effects of tinted CL's on baseball performance through analysis of on-field results.

Baseball has extremely high visual demands. Batting and fielding require the player to see the baseball precisely, distinguish it from the background and deal with glare from the sun and other reflective surfaces. Based on the results of prior laboratory studies we hypothesized that wearing the SportSight tinted lenses would improve both batting and fielding performance by reducing the deleterious effects of glare and improving contrast through the filtering of short wavelength visible light and select transmission at longer wavelengths .

Objective results confirmed the hypothesis that tinted CL's would improve batting performance. The tinted SCL group showed greater improvement in every major batting percentage statistic (batting average, slugging percentage, on-base percentage and walk to strike out ratio) than the rest of the team from the first half of the season to the second half of the season. The tinted CL group showed less dramatic improvement in fielding performance than in their batting performance. However, the tinted CL group did perform equally to the rest of the team in objective measures of fielding performance.

The performance questionnaires filled out at the end of the season indicated that all subjects felt there were advantages to wearing the tinted CL's (see Table III). The four participants who completed the study all agreed or strongly agreed that if given a choice they would continue to wear the SportSight SCLs for baseball practice and games (see Table III). While the results of the subjective questionnaire were in general very positive, the CL's were reported to be especially effective during overcast conditions, at dusk and during night games. One participant commented that "more improvement was

noticed when it was cloudy" and another participant wrote that the SportSight SCLs "worked best when the sun was going down."

The small number of subjects precludes this study from achieving a statistical significance. However, while the number of participants in this study was limited, the impressive objective and subjective results suggest the need for further investigation. This study should be expanded to include more players to improve validity of the findings.

The scope of the current study was limited by the number of participants wearing the tinted CLs. While the current study included only habitual CL wearers, future studies should include emmetropes and non-CL wearers. This would not only increase the number of subjects but also create a study population that more closely mirrors the actual demographics of the sports participants.

Further research should investigate efficacies of different for different light conditions. For example, while the tint in the current study was felt to be effective for low light conditions, the use of a darker tint may be superior for bright or sunny conditions. Finally, the use of a tint to improve athletic performance is not limited to baseball. Future research should investigate the use of tinted CL's with other outdoor sports such as golf or tennis.

Insert Tables I, II and III about here

TABLE I
Summary of Batting and Fielding Statistics from 1st and 2nd Halves of the 2000-2001 Season

1st Half															
	AVE	AB	H	TB	SLG%	BB	HBP	SF	SO	OB%	BB/SO	PO	A	E	FLD%
Player 1	0.234	47	11	13	0.277	3	0	0	7	0.28	0.429	24	39	4	0.94
Player 2	0.286	49	14	22	0.449	4	3	2	9	0.362	0.444	8	16	5	0.828
Player 3	0.379	29	11	18	0.621	3	0	0	8	0.438	0.375	12	0	1	0.923
Player 4	0.194	31	6	10	0.323	1	0	0	4	0.219	0.25	58	4	1	0.984
4 Player Total	0.269	156	42	63	0.404	11	3	2	28	0.326	0.393	102	59	11	0.936
Rest of Team	0.283	403	114	157	0.39	41	16	5	76	0.368	0.539	316	130	26	0.945
Team Total	0.279	559	156	220	0.394	52	19	7	104	0.356	0.5	418	189	37	0.943
2nd Half															
	AVG	AB	H	TB	SLG%	BB	HBP	SF	SO	OB%	BB/SO	PO	A	E	FLD%
Player 1	0.367	79	29	34	0.43	4	0	2	4	0.388	1	35	87	10	0.924
Player 2	0.362	58	21	35	0.603	7	4	1	7	0.457	1	0	1	1	0.5
Player 3	0.344	64	22	34	0.531	3	1	0	14	0.382	0.214	32	1	1	0.971
Player 4	0.29	31	9	12	0.387	6	3	0	4	0.45	1.5	89	5	1	0.989
4 Player Total	0.349	232	81	115	0.496	20	8	3	29	0.414	0.69	156	94	13	0.951
Rest of Team	0.324	429	139	176	0.41	50	13	7	93	0.405	0.538	335	141	18	0.964
Team Total	0.33	661	220	291	0.44	70	21	10	122	0.408	0.574	491	235	31	0.959

AVG = Batting Average, AB = Number of At-Bats, H = Number of Hits, TB = Number of Total Bases, SLG% = Slugging Percentage, BB = Number of Walks, HBP = Number of Hits By Pitch, SF = Number Sacrifice Flies, SO = Number of Strike-Outs, OB% = On Base Percentage, BB/SO = Walk to Strike-Out Ratio, PO = Number of Put Outs, A = Number of Assists, E = Number of Errors, FLD% = Fielding Percentage

TABLE II
Comparison of 2nd and 1st Half Statistics for 2000-2001 Season

2nd Half vs. 1st Half					
	AVG	SLG%	OB%	BB/SO	FLD%
Player 1	57%	55%	39%	133%	-2%
Player 2	27%	34%	26%	125%	-40%
Player 3	-9%	-14%	-13%	-43%	5%
Player 4	49%	20%	105%	500%	1%
4 Player Total	30%	23%	27%	76%	2%
Rest of Team	14%	5%	10%	-0.10%	2%
Team Total	18%	13%	15%	15%	2%

AVG = Batting Average, SLG% = Slugging Percentage, OB% = On Base Percentage, BB/SO = Walk to Strike-Out Ratio, FLD% = Fielding Percentage

TABLE III
SUBJECTIVE QUESTIONNAIRE RESULTS

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

First Day Of Season Type 1 Short Form*

	Player 1	Player 2	Player 3	Player 4	Average	Player 5
Improved ability to see the baseball	3	2	2	2	2.25	3
Improved ability to see the seams of the ball while batting	2	3	3	3	2.75	3
Improved depth perception.	3	3	3	3	3	2
Reduced the brightness of the sunlight on the field	1	2	2	1	1.5	3

End Of Season Type 1 Short Form*

	Player 1	Player 2	Player 3**	Player 4	Average	Player 5***
Improved ability to see the baseball	2		2	2	2	3
Improved ability to see the seams of the ball while batting	1		3	3	2.33	3
Improved depth perception.	3		2.5	3	2.83	2
Reduced the brightness of the sunlight on the field	2		2	1	1.67	3

End Of Season Type 2 Expanded Form*

	Player 1	Player 2	Player 3	Player 4	Average	Player 5**
Batting performance improved this season (TCLs) relative to last season (CCLs)	2	2	3	2	2.25	3
Batting performance improved with the TCLs vs. CCLs (this season)	2	2	3	2	2.25	3
TCLs improved ability to see the baseball while batting	2	2	2.5	3	2.375	3
Fielding performance improved this season (TCLs) relative to last season (CCLs)	2	3	3	2	2.5	3
Fielding performance improved with TCL's vs. CCL's (this season)	2	3	3	3	2.75	3
TCLs improved ability to see the baseball while fielding	2	3	3	3	2.75	4
You would like to continue to wear TCLs to play baseball	2	1	2	1	1.5	4
You would recommend wearing the TCLs to other baseball players.	2	1	2	1	1.5	3
There were negative aspects to wearing TCLs for baseball	3	5	N/A	3	3.67	2
TCLs provided equal benefits in all weather/lighting conditions.	2	4	N/A	2	2.67	4
TCLs were better for baseball performance than other sunglasses/sunwear	2	2	2	1	1.75	3

*See Appendices A and B for exact question wording

**Player 3 did not answer questions 9 and 10 on the expanded questionnaire. Subsequently, his lack of response to those questions was not averaged with those of the other participating players

***Player 5 withdrew from the study before its completion. His results are listed but were not averaged with the four players who completed the study.

References

1. Pitts, Donald G. Ocular Effects of Radiant Energy. In: Pitts, Donald G., Kleinstein, Robert N. *Environmental Vision – Interactions of the Eye, Vision, and the Environment*. USA: Butterworth-Heinemann 1993; 161-180
2. Reichow, AW. *Light Architecture™ Technology: The Science Behind SportSight™ GP*, Paragon Vision Sciences, Inc. Product Collateral, 2000.
3. Pitts, Donald G. Ocular Effects of Radiant Energy. In: Pitts, Donald G., Kleinstein, Robert N. *Environmental Vision – Interactions of the Eye, Vision, and the Environment*. USA: Butterworth-Heinemann 1993; 309
4. Nippon, Ganka, Gakkai, Zasshi, [Retinal Hazard from blue light emitting diode]. 2001 Oct; 105 (10): 687-95. Japanese
5. 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;May;102(5): 799-804
6. Ham WT, Jr, Ocular Hazards of Light Sources: Review of Current Knowledge, *J Occup Med* 1983;25(2)101-103
7. MacEwan, CJ. Light and lighting: light damage and the eye. In: *SportsVision*. USA: Butterworth-Heinemann 1995; Chapter 6
8. 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
9. Corth R. The perception of depth contours with yellow goggles – An alternative explanation. *Perception* 1985;14:377-378
10. Kinney JAS, Luria SM, Schlichting CL, Neri DF. The perception of depth contours with yellow goggles. *Perception* 1983;12:363-366
11. Kinney JAS. The perception of depth contours with yellow goggles – comments on letter by Richard Corth. *Perception* 1985;14:378-379
12. Kopp, J. David, Eye on the ball: an interview with Dr. C. Stephen Johnson and Mark McGwire, *JAM OPTOMASSOC*, Volume 70, Number 2/February 1999, 79-84
13. Reichow, AW, Fredlund, KM, Treike, KD, Whitehouse, KD, Carmiencke, KL. Optometric Trends in Sports Vision: A Two Decade Review; In-Press: *JAM OPTOM ASSOC*; Spring 2002.
14. 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. 2001
15. Waddell J, Hashimoto L, Broecker E, Reichow AW, Citek K. Comparative Study of Visual Performance with Tinted 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. 2000
16. Reichow AW, *Light Architecture Technology: The Science Behind SportSight GP*, Paragon Vision Sciences, Inc. Product Brochure, 2000
17. Geis T, Johns H, Perea S, Rossman A, Ebeler A, Phillips L, Sifferman L, Reichow A, Citek K, Caroline P. Interaction of Iris Color and Determination of Appropriate Visible Light Transmissions of SportSight Contact Lenses, 1999
18. 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

19. 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, 1999
20. Elliot A, Reislter 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. 1999

Acknowledgements

We would like to thank the following people for their help and support of this project:

- Paragon Vision Sciences, Inc. for their grant support
- **Graham Erickson**, O.D., F.A.A.O., C.O.V.D. for his assistance in reviewing this article
- The baseball players and coaches from **Pacific** University for their participation **and** input

Appendix A

SportSight Contact Lens Questionnaire

For the following questions, circle your responses on a scale of 1 to 5. Space for comments is provided.

1. The SportSight Contact Lenses improved your ability to see the baseball in general.

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

Comments:

2. The SportSight Contact Lenses improved your ability to see the seams of the baseball during batting practice.

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

Comments:

3. The SportSight Contact Lenses improved your depth perception.

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

Comments:

4. The SportSight Contact Lenses reduced the brightness of the sunlight on the field, making it easier to see.

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

Comments:

Appendix B

SportSight Contact Lens Questionnaire

For the **following** questions, circle **your** responses on a **scale** of 1 to 5. **Space** for comments is provided.

1. In your opinion, did the SportSight Contact Lenses help to improve your batting performance this season relative to last season?

<u>1</u>	<u>2</u>	<u>3</u>	<u>4</u>	<u>5</u>
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Comments:

2. In your opinion, did the SportSight Contact Lenses help to improve your batting performance in the second half of the season relative to the first half of the season?

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

Comments:

3. The SportSight Contact Lenses improved your ability to see the baseball while batting during games.

<u>1</u>	<u>2</u>	<u>3</u>	4	5
Strongly Agree	Agree	Neutral	Disagree	Strongly Disagree

Comments:

4. In your opinion, did the SportSight Contact Lenses help to improve your performance in the field this season relative to last season?

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

Comments:

5. In your opinion, did the SportSight Contact Lenses help to improve your performance in the field in the second half of the season relative to the first half of the season?

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

Comments:

6. The SportSight Contact Lenses improved your ability to see the baseball while fielding during games.

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

Comments:

7. If given the choice, you would continue to wear the SportSight Contact Lenses for baseball practice and games.

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

Comments:

8. You would recommend wearing the SportSight Contact Lenses to teammates or other baseball players.

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

Comments:

9. There were 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

Comments:

10. The SportSight Contact Lenses provided **equal** benefits in all **weather/lighting** conditions (If you disagree, please **comment** on which conditions **you** noticed **the most/least** benefits **and why**).

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

Comments:

11. The SportSight Contact Lenses were more beneficial to your baseball performance than other **sunglasses/sunwear** you have used in the past.

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

Comments: