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Visual performance with tinted contact lenses

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Visual performance with tinted contact lenses

Abstract
During extensive research of the several tinted contact lenses on the market, a lack of information was noted as to whether or not tinted contact lenses can effect visual acuity under conditions of varying contrast. With this in mind we conducted a study to determine the effect of tinted contact lenses on visual performance under high and low contrast conditions. Using twenty-four research subjects, high and low contrast visual acuities were documented in order to compare performance with tinted to clear contact lenses. Two tints were chosen, royal blue and evergreen, with each person serving as their own control by wearing a pair of clear lenses. Subjects accepted for the study were required to have small refractive errors, + 1.00 to -4.00 diopters with astigmatism less than 0.75 diopters. Acuities were measured using Bailey-Lovie LogMAR contrast acuity charts, and the data analyzed with paired t-tests. The data showed that visual acuity decreased by approximately 1/2 a Snellen line under high and low contrast conditions compared to the clear lens performance. These data suggest that visual performance deficits can occur when tinted lenses are prescribed for cosmetic purposes, particularly under conditions of varying contrast. This may have impact in situations ranging from safety in the workplace to performance in sports or fine visual motor tasks, and it is suggested that patients be informed of possible difficulties when wearing deeply tinted cosmetic lenses.

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Thesis

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VISUAL PERFORMANCE
WITH
TINTED CONTACT LENSES

BY
JAY L. BORGHOLTHAUS
JENNIFER R. DEMEERLEER
JOAN L. HELLER
WILLIAM R. SHRECK

A thesis submitted to the faculty of the
College of Optometry
Pacific University
Forest Grove, Oregon
for the degree of
Doctor of Optometry
May 1991

Advisor:
Cristina Schnider, O.D.
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ADVISOR:

CRISTINA SCHNIDER, O.D.
Originally from Payette, Idaho, Jay grew up with examples of the medical profession, his father being a dentist and his uncle, an optometrist. These influences in his life helped him to lead a course toward optometry school via undergraduate studies at Brigham Young University. He was accepted to Pacific University College of Optometry in 1987 and furthered his studies by obtaining a Visual Science degree in 1989 which will enable him to achieve the Doctorate degree in Optometry.

After graduation, Jay plans to remain in the Pacific Northwest with his wife and son to pursue a career in a full-scope private practice.
JENNIFER R. DEMEERLEER

Jennifer DeMeerleer was born and raised in the Pacific Northwest, and is currently residing in Forest Grove, Oregon where she has attended Pacific University College of Optometry since 1987. While working part-time in the private practice of an Optometrist during her high school and undergraduate years, Miss DeMeerleer developed a strong interest in the eye care field. She attended Pacific University for two years of undergraduate studies before being accepted into their optometric graduate program the fall of 1987. She received her Bachelor's degree in Visual Science, Magnum Cum Laude, in the spring of 1989.

Jennifer DeMeerleer would like to further her education in full-scope optometry and her special interests of contact lenses and geriatric optometry by pursuing a residency program following graduation in May of 1991.
Joan Heller is originally from Denver, Colorado. A career in the health sciences had been of interest to Joan since early childhood. As a student at the University of Colorado, Joan narrowed her goals in the health field to Optometry. After completion of her undergraduate degree, Joan was accepted to Pacific University College of Optometry. She began her studies in the fall of 1987.

During her four year optometry program Joan became interested in many areas of study. Her chief interests lie in the areas of vision therapy, contact lenses and a special interest in low vision.

Upon graduation, Joan hopes to enter into a full scope practice with an established practitioner. This will enable her to further her areas of interest while continuing to educate herself in primary care.
William is originally from Broomfield, Colorado. He began his undergraduate studies in the fall of 1984 at Colorado State University. While at Colorado State University, William gained an interest in the optometric profession. He was accepted to Pacific University College of Optometry in 1987 and furthered his studies by receiving a Bachelor's degree in Visual Science in the spring of 1989.

Upon graduation from Pacific University College of Optometry in the spring of 1991, William will return to Colorado to set up a full-scope optometric practice with special emphasis on contact lenses, ocular pathology, and pediatric orthoptics.
ABSTRACT

During extensive research of the several tinted contact lenses on the market, a lack of information was noted as to whether or not tinted contact lenses can effect visual acuity under conditions of varying contrast. With this in mind we conducted a study to determine the effect of tinted contact lenses on visual performance under high and low contrast conditions. Using twenty-four research subjects, high and low contrast visual acuities were documented in order to compare performance with tinted to clear contact lenses. Two tints were chosen, royal blue and evergreen, with each person serving as their own control by wearing a pair of clear lenses. Subjects accepted for the study were required to have small refractive errors, +1.00 to -4.00 diopters with astigmatism less than 0.75 diopters. Acuities were measured using Bailey-Lovie LogMAR contrast acuity charts, and the data analyzed with paired t-tests. The data showed that visual acuity decreased by approximately 1/2 a Snellen line under high and low contrast conditions compared to the clear lens performance. These data suggest that visual performance deficits can occur when tinted lenses are prescribed for cosmetic purposes, particularly under conditions of varying contrast. This may have impact in situations ranging from safety in the workplace to performance in sports or fine visual motor tasks, and it is suggested that patients be informed of possible difficulties when wearing deeply tinted cosmetic lenses.

Key Words: Visual performance, contrast sensitivity, tinted contact lenses, low contrast, high contrast, logMAR units.
Acknowledgements

The authors of this project wish to thank Dr. Cristina Schnider for her advise and expertise in dealing with contact lenses and statistical analysis.

We also wish to thank the Ciba and Bausch and Lomb Companies for their support with materials supplied for this project.
Visual Performance
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Tinted Contact Lenses

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William R. Shreck
INTRODUCTION

"Five foot two, Eyes of blue, Oh what those five feet can do, Has anybody seen my gal". Songs like this have sparked an interest in appearance of eye color. With current technology an individual can now, by choice, choose their own eye color. Whether the lens color is tinted blue, green, or even purple, any variation from a clear lens may cause a person to wonder, "how much of my vision is being affected?" Today's eye care practitioners must also concern themselves with the possible visual hindrances associated with tinted lenses. One method of examining these disturbances is by testing visual acuity under varying conditions, rather than just under optimal conditions (high contrast, moderate to high illumination) as suggested by Josephson, et al.(5) Contrast levels can vary significantly in a person's normal daily activities. These variations occur not only during normal daylight vision; but also in night vision, sporting activities, restaurant dining and any area of life where variation of lighting and contours occur. Since vision becomes increasingly important for interpersonal and behavioral communication an optometrist should not solely be concerned with a person's vision under standard optometric testing conditions (i.e., high contrast Snellen acuity).

Accordingly, we chose to investigate the area of tinted contact lens use under both high and low contrast conditions. Specifically we selected CIBA STD royal blue and evergreen lenses. Royal blue and evergreen lenses were selected due to the fact that they have the highest density of color of commonly available tinted lenses and therefore are likely to cause the greatest deficit in contrast sensitivity. The Ciba lenses were chosen because their tint is applied across the entire central portion of the lens. The Bailey-
Lovie chart was chosen due to its sensitivity in detecting subtle changes in visual function. (1,2)

METHODS

Previous contact lens wearers were solicited for screening for participation in the study. Of those screened, 24 people were selected on the basis of refractive error and biomicroscopic examination. The subjects selected were between the ages of 18 and 30, with refractive errors of +1.00 to -4.00 D with astigmatism less than 0.75D. All patients with anterior ocular health contraindications to soft contact lens were excluded from the research. These conditions included giant papillary conjunctivitis, pterygia, tear film dysfunction, corneal/conjunctival abnormalities, etc.

Each patient was fitted with a pair of clear and a pair of tinted lenses at an initial fitting visit. Lenses were fitted to achieve full corneal coverage and good centration and movement characteristics. At the dispensing visit, each patient was given the same standard regimen of care for their lenses (AOSEPT) as provided by CIBA. An adaptation period of one week was given, where subjects were asked to wear their lenses at least 4 to 6 hours per day. The subjects were then recalled for a single experimental session.

Prior to testing, all subjects underwent a second biomicroscopic examination on both clear and tinted lenses. This was done to ensure both a proper fit and clean lenses.

Subjects were tested on logarithmic scaled Bailey-Lovie high and low contrast visual acuity charts provided by Bausch and Lomb. The actual chart contrast between the background and letters was approximately 85% high contrast and 7% low contrast. All testing was performed at
the prescribed test distance of four meters. The advantage of using these charts was that they offered alternate letter sequences from the standard projected Snellen chart and hence prevention of patient memorization of the letters. Room illumination during testing was standardized and monitored at the testing site using a photometer at 15 footcandles.

The study used only routine procedures performed in clinical practice. This involved an overrefraction performed by the same examiner for all subjects in order to maintain consistent results. With best corrected sphero-cylindrical overrefraction in the phoropter, visual acuities were taken using first the low contrast chart followed by the high contrast chart. To standardize testing procedures, acuities were taken with the tinted lenses first, followed by the clear lenses.

The data for each subject's right eye were then statistically analyzed via a computerized paired t-test. The log MAR value for visual acuity was utilized in the analyses.
RESULTS

Vision results are expressed as LogMAR or Log of the minimum angle of resolution, where 20/20 is expressed as 0 (Log 1). Therefore, acuities better than 20/20 are expressed as negative values, and acuities worse than 20/20 are positive. The Bailey-Lovie charts contain 5 letters to a line, and each line equals 0.1 unit on the LogMAR scale.

Table 1 summarizes visual acuity data gathered under the various test conditions. Note that both green and blue lenses caused a mean reduction in visual acuity for high and low contrast conditions. However, there was no difference between green and blue lens findings, so they will be treated as a single group for discussion purposes.

(Insert Table 1)

Table 2 presents the statistical analysis of this data. Statistically significant decreases were found for visual acuity under both high and low contrast conditions for colored lenses compared to clear lenses on the same individuals. These decreases correspond to a mean loss of about 3 letters for high and low contrast conditions when compared to the performance with clear lenses under the same testing conditions.

(Insert Table 2)
DISCUSSION

The results clearly demonstrate a loss in visual performance with the deeply tinted hydrogel lenses used in this study compared to their clear counterparts. While not every patient demonstrated such losses, it is obvious that some may experience increased difficulties with fine acuity tasks when wearing tinted lenses, especially during conditions involving low contrast targets or low light levels. These data suggest that acuities should be carefully tested when tinted hydrogels are prescribed, and that results with clear lenses alone not be relied upon. Other data in the literature shows that contrast sensitivity losses can occur during soft lens wear. (3,4,5) Others report that since the mechanism of contrast sensitivity loss is unknown, it is apparent that the loss is often refractive because the degradation of vision is generally not correctable by altering the refractive power of the contact lens.(6) In this case, an alteration in the retinal luminance levels may be a factor, verses a shift in sensitivity due to the “band pass” filter placed on the cornea.
REFERENCES


### TABLE 1 - VISUAL ACUITY RESULTS

#### X1: HCVA CLEAR

<table>
<thead>
<tr>
<th>Mean:</th>
<th>Std. Dev.:</th>
<th>Std. Error:</th>
<th>Variance:</th>
<th>Coef. Var.:</th>
<th>Count:</th>
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<tbody>
<tr>
<td>.01</td>
<td>.076</td>
<td>.016</td>
<td>.006</td>
<td>757.816</td>
<td>22</td>
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<tr>
<td>Minimum:</td>
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<td>-.14</td>
<td>.14</td>
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<td>.22</td>
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#### X2: HCVA COLOR

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<td>.019</td>
<td>.008</td>
<td>131.327</td>
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<td>1.46</td>
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#### X3: LCVA CLEAR

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**TABLE 2**  **STATISTICAL ANALYSIS, ALPHA = 0.05**

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<td><strong>Y₁</strong>: HCVA COLOR</td>
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<tr>
<td>DF:</td>
<td>Mean X - Y:</td>
<td>Paired t value:</td>
<td>Prob. (2-tail):</td>
</tr>
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<td>21</td>
<td>-.056</td>
<td>-3.852</td>
<td>.0009</td>
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<thead>
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<th>Paired t-Test</th>
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<tbody>
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<td><strong>X₂</strong>: LCVA CLEAR</td>
<td><strong>Y₂</strong>: LCVA COLOR</td>
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<tr>
<td>DF:</td>
<td>Mean X - Y:</td>
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