A COMPARISON OF CONTRAST SENSITIVITY OF LIGHT AND DARK COLORED ENHANCING CONTACT LENSES

by

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ABSTRACT

Background: Previous studies have investigated the relationship between soft contact lenses and contrast sensitivity, and it is known that contact lenses in general reduce contrast sensitivity (CS).[1-5] It is also known that opaque cosmetic lenses reduce CS to an even greater degree, but our goal is to determine whether the lightly tinted enhancing contact lenses cause a significant difference in CS.[9] *Methods:* Twenty-six optometric students were fit empirically with both a light and dark blue version of CIBA Focus Softcolors. Visual performance was evaluated via monocular and binocular CS and monocular and binocular visual acuity measurements. *Results:* The data and analysis with t-tests show that there was little effect on CS when wearing enhancing contact lenses. *Conclusions:* Enhancing contact lenses do not adversely affect CS. Furthermore, there was no difference between the lighter colored enhancer contact lens and the darker colored enhancer contact lens. Further study into this issue could include a larger sample size, however, clinicians should not hesitate to offer patients this option for contact lens correction.

ACKNOWLEDGEMENTS

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A COMPARISON OF CONTRAST SENSITIVITY OF LIGHT AND DARK COLORED ENHANCING CONTACT LENSES

Abstract:

Background: Previous studies have investigated the relationship between soft contact lenses and contrast sensitivity, and it is known that contact lenses in general reduce contrast sensitivity (CS).[1-5] It is also known that opaque cosmetic lenses reduce CS to an even greater degree, but our goal is to determine whether the lightly tinted enhancing contact lenses cause a significant difference in CS.[9] *Methods:* Twenty-four optometric students were fit empirically with both a light and dark blue version of CIBA Focus Softcolors. Visual performance was evaluated via monocular and binocular CS and monocular and binocular visual acuity measurements. *Results:* The data and analysis with t-tests show that there was little effect on CS when wearing enhancing contact lenses. *Conclusions:* Enhancing contact lenses do not adversely affect CS. Furthermore, there was no difference between the lighter colored enhancer contact lens and the darker colored enhancer contact lens. Further study into this issue could include a larger sample size, however, clinicians should not hesitate to offer patients this option for contact lens correction.

Methods:

The twenty-four participants consisted of optometry students who had no history of refractive surgery or ortho-keratology correction. The refractive errors were limited to between four diopters of hyperopia and six diopters of myopia with no more than 0.75

diopters of astigmatic correction. In addition, the subjects were required to sign a consent form approved by Ferris State University Human Subjects Review Committee.

CIBA Focus Softcolors (Duluth, GA) is an enhancer lens that features a tint that covers both the iris and pupil areas. This lens has a 14.0 mm overall diameter and 11.0 mm tinted diameter. Keratometry readings were used to determine the base curve used. A base curve of 8.8mm was used if readings were 45.00 diopters or flatter and a base curve of 8.4mm is used if readings were steeper than 45.00 diopters. Any existing refractive errors were corrected by the contact lenses and spherical equivalents were used when necessary.

Both a Bailey-Lovie chart and Pelli-Robson chart were placed next to each other and used at a distance of three meters from the participants to maintain similar lighting conditions and minimize any affects of accommodation. Lighting conditions mimicked that which is found in most exam rooms and was measured at less than 20 ft-candles. Pupil measurements were determined with a pupil gauge by the same examiner.

Visual acuity, contrast sensitivity and pupil measurements were initially taken with the subject's habitual correction (see Table 2 & Table 3). The contact lens colors Aqua and Royal Blue were used, and the order was randomly selected at the time of data collection.

Contact lenses were allowed to settle for approximately ten minutes prior to acuity measurements. Visual acuities and CS were taken after an enhancing contact lens with the subjects prescription was placed on both eyes. Each subject was instructed to read the lowest line possible, beginning with the Bailey-Lovie and then the Pelli-Robson. VA was recorded as the logarithm of the minimum angle of resolution (log MAR), and CS was scored per letter with each letter being worth .05 log units. Slit lamp examination of the participant's corneas, media, and lens was conducted to ensure acceptable ocular health. In addition, the contact lenses were evaluated to ensure an acceptable fit and movement on the eye.

Results:

The twenty-four participants had refractive errors ranging from +1.00 D to -5.25 D. The subjects included 14 women and 10 men ranging in age from 21 to 33. The subjects were divided into three groups including those who habitually wore no correction, those with spectacles, and those with contact lenses.

Pupil size was measured with the smallest pupil size being four millimeters and the largest pupil size being seven millimeters. The pupil sizes of the participants with differing CS show that three out of eleven participants have pupil size changes. The

participant with a better CS with the Royal Blue lens and habitually wears spectacles has a larger pupil when wearing the Royal Blue contact lens. In contrast, the two participants with a decrease CS with both colored contact lenses have a smaller pupil when wearing the Royal Blue contact lenses.

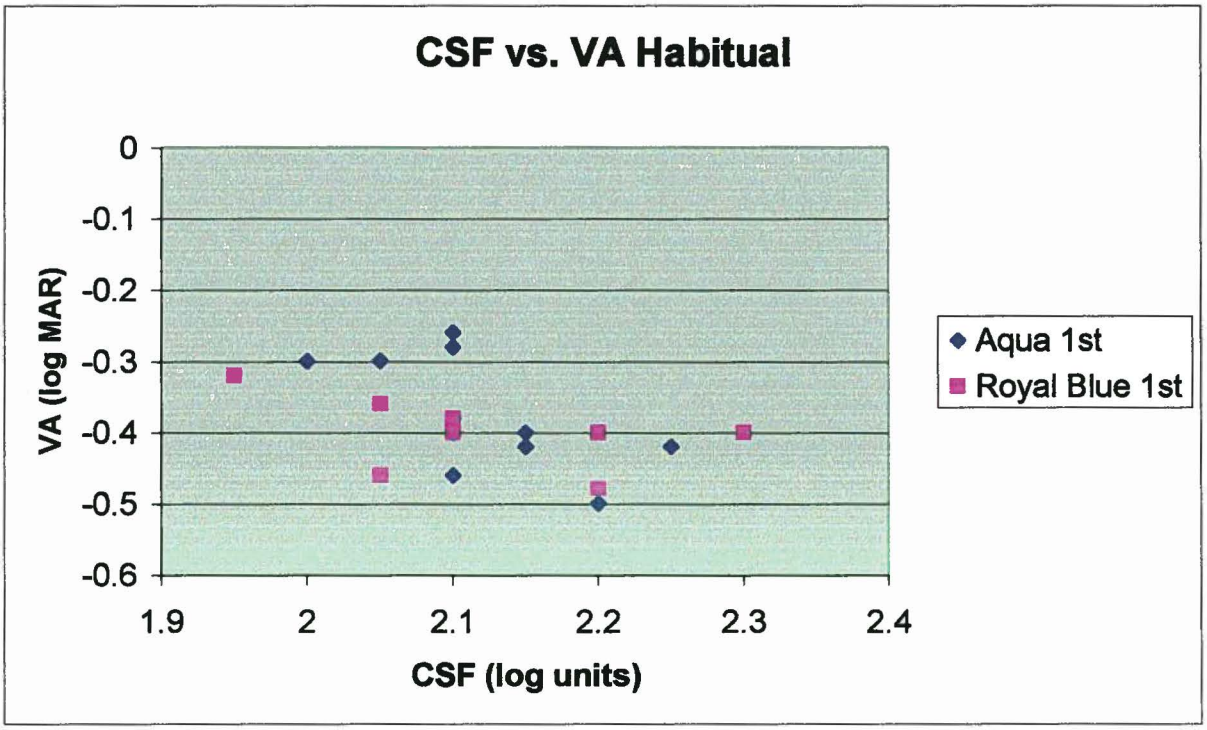

Figure 1. CSF vs. VA Habitual

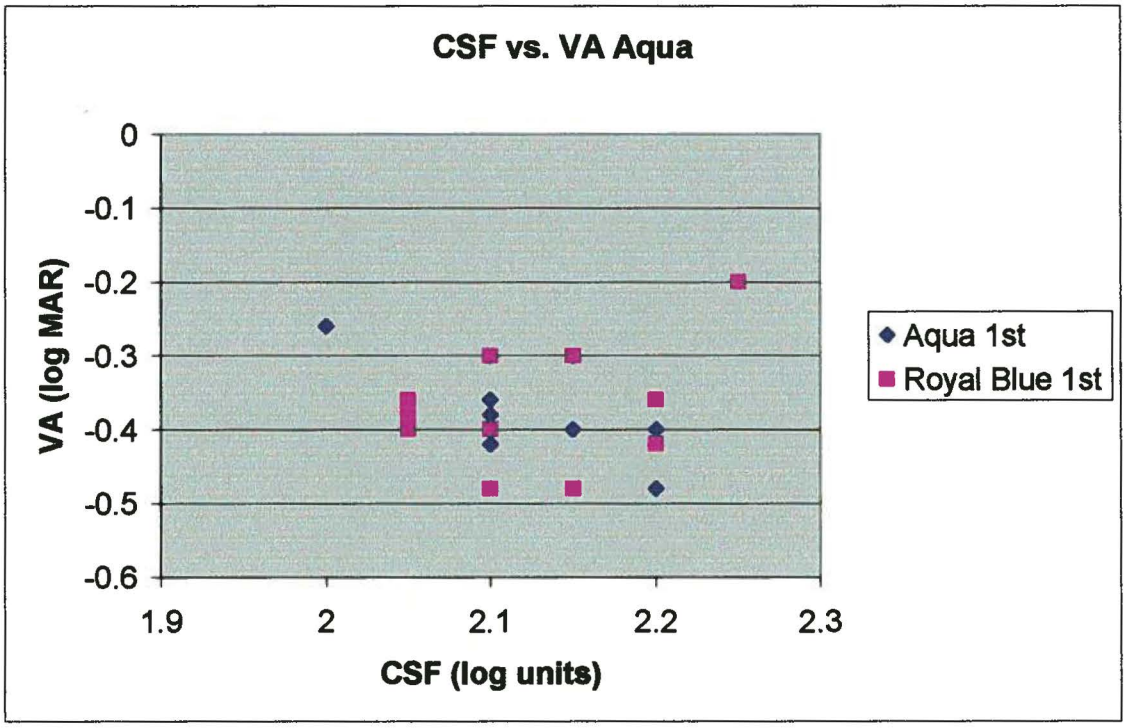

Figure 2. CSF vs. VA Aqua

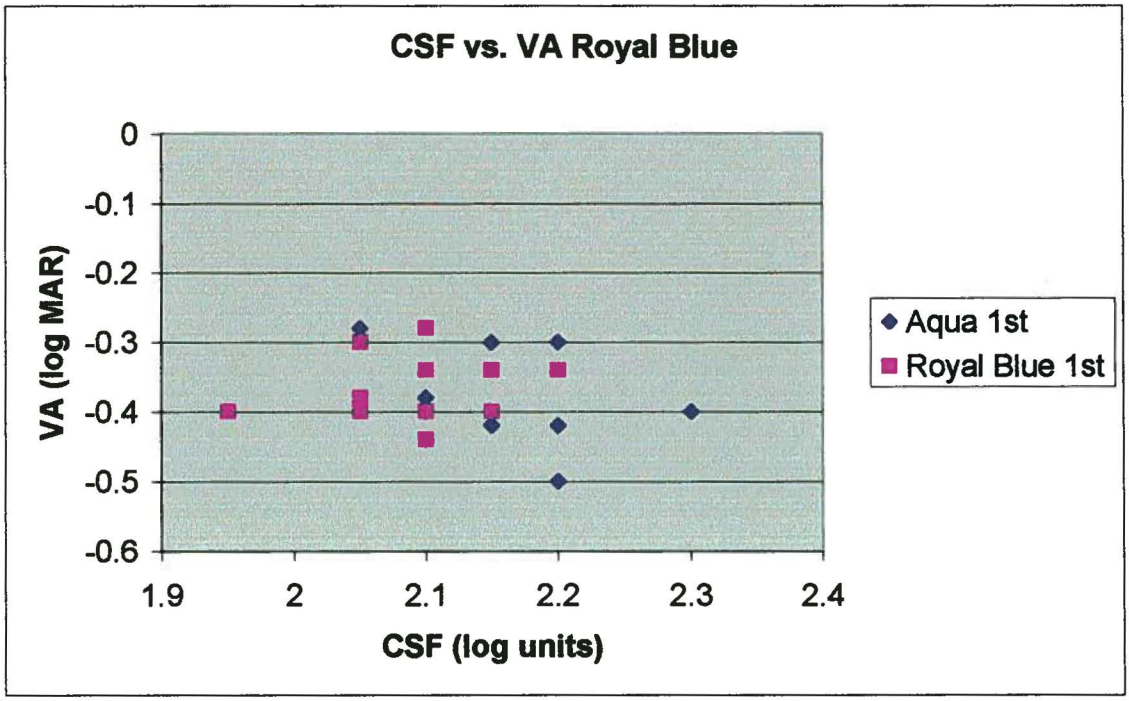

Figure 3. CSF vs. VA Royal Blue

Table 1. Mean Contrast Sensitivity (log units)

	OD	OS	OU
Habitual (Aqua 1st)	2.00	1.97	2.12
Habitual (Royal Blue 1st)	1.94	1.93	2.11
Aqua (Aqua1st)	1.98	1.96	2.13
Royal Blue (Aqua 1st)	2.03	1.99	2.15
Royal Blue (Royal Blue1st)	1.93	1.97	2.09
Aqua (Royal Blue 1st)	1.98	1.95	2.13

Additionally, for the Aqua First group, the average base line acuity is measured as -0.383 OU (an estimated 20/20-20/15) versus -0.375 OU with the Aqua lens and Royal Blue lens. For the Royal Blue First group, the average base line acuity is -0.386 OU versus -0.329 (an estimated 20/20) with the Royal Blue lens and -0.35 with the Aqua lens. There are 15 participants who maintained the same acuity OU throughout the study. Four participants maintain an acuity of 20/20 and 11 had an acuity that was better than 20/20. Two participants show an improved acuity reading with both colored contact lenes and five have a decreased acuity reading with the colored contact lenses.

Three participants have their worse acuity reading while wearing the Royal Blue contact lenses and one participant with the Aqua contact lenses. Two participants that show an improvement, one habitually wears spectacles and the other wears contact lenses. Those that show a decrease in acuity, two habitually wear contact lenses and the remaining six wear spectacles or no correction. One of the previously mentioned participants, who have the worse acuity when wearing the Royal Blue contact lens, shows an improved acuity from habitual (contact lenses) with the Aqua lens.

Aqua First Refractive Error	Habitual	Keratometry Readings	Pupil Size Habitual (mm)	Pupil Size Aqua (mm)	Pupil Size Royal Blue (mm)
-0.25/+0.25	None	Flat	5	5	5
-1.25/-1.25	Glasses	Flat	7	7	6
Plano/Plano	None	Flat	5	5	5
-2.00/-2.75	Glasses	Flat	4	5	5
-3.00/-3.50	Glasses	Flat	5	5	5
-5.00/-5.25	Glasses	Flat	6	6	5
+0.75/-0.75	Contacts	Steep	5	5	5
Plano/Plano	None	Flat	6	6	6
-2.50/-2.75	Contacts	Flat	5	5	5
Plano/Plano	None	Flat	5	5.5	5
-2.25/-2.75	Contacts	Flat	4	5	4
-0.75/-0.75	Glasses	Steep	6	6	6

Table 2. Aqua First group's initial data and pupil measurements

Royal Blue First Refractive Error	Habitual	Keratometry Readings	Pupil Size Habitual (mm)	Pupil Size Royal Blue (mm)	Pupil Size Aqua (mm)
-1.75/-2.00	Contacts	Flat	5	6	5.5
-1.75/-1.00	Contacts	Flat	4	4	5
-1.75/-2.75	Glasses	Steep	5	6	5
Plano/Plano	None	Flat	5	5	5
-3.00/-3.25	Contacts	Flat	7	7	7
Plano/Plano	None	Flat	5	6	5
-2.50/-3.50	Contacts	Flat	6	6	6
Plano/Plano	None	Flat	5	5	5
-1.00/-1.00	Glasses	Flat	6	6	6
-2.75/-3.25	Contacts	Flat	5	5	5
+1.00/+1.00	Glasses	Flat	5	4	5
-4.75/-4.75	Glasses	Flat	5	5	5
-1.00/-1.25	Glasses	Flat	6	6	6
-4.00/-4.00	Contacts	Flat	5	6	7

Table 3. Royal Blue First group's initial data and pupil measurements

In comparing habitual contact lens wearers to those who did not previously wear contact lenses, none of the contact lens wearing group had a loss of CS. There are four

participants with a decrease CS, where two show a decrease with both the Aqua and Royal Blue contact lens and the other two with a decrease with the Royal Blue contact lens only. Similarly, there was a smaller percentage of contact lens wearers who demonstrated a decrease in acuity, 25% versus 75%. These participants either had the same pupil size throughout the study (3 participants) or a larger pupil with one of the colored contact lenses (4 participants) or had a smaller pupil with the Royal Blue lens (2 participants). With the t-test, no significant difference ($p < 0.05$) was obtained between either habitual compared to aqua, habitual compared to royal blue, or aqua compared to royal blue (see Figure 4).

Table 4. T-Test Results ($p \leq .05$)

	Habitual/Aqua	Habitual/Royal Blue	Aqua/Royal Blue
OD	.595	.782	.874
OS	.869	.175	.149
OU	.478	.802	.560

Conclusion:

Preceding studies have evaluated the effects of contact lenses on CS due to patients' inexplicable complaints of less than optimal vision.[1-5] CS function is a more appropriate measurement of acuity due to its sensitivity of finding differences in visual function[6]. Opaque colored contact lenses have been included in this evaluation; however, an enhancing colored contact lens has not been evaluated. The enhancing colored contact lens is different to an opaque colored contact lens in that it does not have a clear pupil. An enhancing colored contact lens differs also from a visibility-tinted contact lens in that

it is able to change the color of a light-eyed patient. Therefore, the affects of this type of lens should be investigated since patients will wear these lenses in a variety of environments and lighting conditions.

An adverse effect on CS has been attributed to many factors, including the contact lens material, tear film, lens deposits, aberrations, and residual astigmatism. A lathe-cut contact lens, like the CIBA Focus Softcolor contact lens, may have a degraded optical quality due to residual siloxane and wax and a decreased wettability of the contact lens[1]. Additionally, individual differences in blink rate and tear film may affect the acuity and CS and are not accounted for in this study.

From earlier studies, a worsening of CS function is found after two weeks of wear and is attributed to lens deposits, lens dehydration, or spherical aberrations.[2,7] The effect of lens deposits should be negligible in this study because the lenses are worn for a maximum of 30 minutes. The flexibility of the soft contact lens should permit the aspheric cornea to reduce spherical aberrations[2]. The effect of residual astigmatism should not be a factor since participants with a large amount of astigmatism are excluded.

This study compares the CS of a light colored enhancing contact lens (Aqua) to a dark colored enhancing contact lens (Royal Blue) and did not find a statistically significant difference between the two colors. Additionally, there is not a difference between these contact lenses and the participants' habitual correction, which included spectacles or contacts or no correction. The result of this investigation has similar findings of previous studies, where the average visual acuity is not adversely affected by contact lenses.[8] Although further study is needed with a larger sample size, clinicians should not hesitate to offer patients this option contact lens correction.

Since there are many participants who habitually wear no correction or spectacles, corneal adaptation changes have the potential to affect CS function. Prior studies have investigated corneal adaptation and swelling is found to peak at the third day of wear. A CS function reduction in the first hour of wear is due to corneal edema, specifically epithelial edema, which is caused by osmotic changes from excessive lacrimation. Another study found mild corneal edema affects high frequency sensitivity with a change in low frequency CS occurring with severe edema[5]. However, this explanation does not explain the decrease in CS for those who are adapted to contact lens wear[3]. In comparing CS of habitual contact lens wearers in our study to the CS of the enhancing lenses, the effect of the visibility tint is negligible. An earlier study compared the CS function of a clear soft lens to a visibility tinted soft lens and the results show the decrease in CS function to be similar[4]. In addition, a study done with CS and hydrogel lenses did not find a decrease in CS after one day or one week of wear[5].

Expectations of the study might include a larger pupil size with the colored contact lens, especially with the Royal Blue contacts. If there is a decrease in CS and/or visual acuity, it may be due to increased aberrations caused by a larger pupil. Another possibility for those who showed a decrease in acuity is residual astigmatism, which would be seen in participants who habitually wear spectacles versus contact lenses or no correction. This would not be seen in contact lens wearers, since the decrease if any would be seen in the habitual CS and acuity measurements. Therefore, a decrease in CS or acuity with the enhancing contact lenses would be due to the contact lenses alone. Finally, a decrease in acuity and CS may be due to adaptation problems with those who are not habitual contact lens wearers.

Further study with a larger sample size should be performed to investigate the effect of this type of contact lens on vision and confirm prior findings. Not only does the effect on CS and visual acuity need to be studied, but other factors that need to be explored include the combination of an enhancing contact lens with corneal adaptation and/or residual astigmatism. First time contact lens wearers and those with minimal astigmatism should be included since many potential and current contact lens wearers are interested in these lenses for cosmetic purposes. Given this interest in cosmetic lenses, clinicians should be aware of any possible hindrance to the visual performance of lens wearers. Also, this information can reinforce the importance of continual exams with an eye care provider for contact lens wearers.

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