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ABSTRACT

This study attempts to resolve the conflicting literature relative to contrast sensitivity function (CSF) and soft contact lens wear. Contrast sensitivity was measured at six spatial frequencies for nineteen subjects (38 eyes) when corrected with both spectacles and soft lenses. Measured amounts of residual astigmatism and/or sphere were corrected using a trial frame and lenses. Additionally, data was evaluated on more than one occasion in order to investigate the effect of time upon visual performance with the lenses. The results indicate a measurable decrease in contrast sensitivity for only the highest of the spatial frequencies tested (22.8 cycles/degree) when soft lenses were worn. For those eyes demonstrating a clinically significant decrease in contrast sensitivity, responsibility appears to be shared by both the contact lens and the cornea. There were no significant changes in CSF over time.

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EFFECTS OF SOFT CONTACT LENSES ON

CONTRAST SENSITIVITY

EFFECTS OF SOFT CONTACT LENSES ON CONTRAST SENSITIVITY

A Thesis Presented to
the Faculty of the Graduate School of
Pacific University

In Partial Fulfillment
of the Requirements for the Degree
Master of Science
in Clinical Optometry (Management Track)

by
David L. Kirkpatrick, O.D.
April 1983

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My last word of acknowledgement delightedly goes to my wife Noreen who has shared my "highs" and endured my "lows" throughout this study. Thank you all.

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ABSTRACT

This study attempts to resolve the conflicting literature relative to contrast sensitivity function (CSF) and soft contact lens wear. Contrast sensitivity was measured at six spatial frequencies for nineteen subjects (38 eyes) when corrected with both spectacles and soft lenses. Measured amounts of residual astigmatism and/or sphere were corrected using a trial frame and lenses. Additionally, data was evaluated on more than one occasion in order to investigate the effect of time upon visual performance with the lenses. The results indicate a measurable decrease in contrast sensitivity for only the highest of the spatial frequencies tested (22.8 cycles/degree) when soft lenses were worn. For those eyes demonstrating a clinically significant decrease in contrast sensitivity, responsibility appears to be shared by both the contact lens and the cornea. There were no significant changes in CSF over time.

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INTRODUCTION AND BACKGROUND

Despite recent advances in the field of soft contact lenses, many problems remain. One such problem is the decrease in "visual function" often found in patients fit with soft contact lenses. Despite their ability to achieve visual acuity comparable to that with their spectacle lenses, these patients frequently complain that their new vision is "not quite as sharp" as it previously had been through their glasses.

Determination of the Contrast Sensitivity Function (CSF) of the human visual system has been shown to be clinically relevant in the evaluation of overall visual performance.[1-21] This is especially true for those conditions which compromise the patient's ability to see images yet spare the ability to recognize fine detail, i.e. patients complain of "hazy" vision yet Snellen acuities and related measures, which depend on resolution of fine detail at contrast ratios approximating 100%, are normal.

There are two independent components to the contrast sensitivity function.[5] One is an optical component which is affected by optical aberrations, diffraction, and scatter which degrade the retinal image. The second is a neural component which, due to anatomical and physiological limitations and interactions, affects the processing of information within the retina and visual pathways. Abnormalities in CSF are usually related to defects in either the optical (corrective lens-eye) system, which affect contrast sensitivity primarily for high spatial frequency perception, or the retina-brain system, which affect contrast sensitivity primarily for low spatial frequency perception. The neural component of the CSF should theoretically remain unaffected by optical changes which affect only the quality of the retinal image. Abnormalities of the CSF in healthy contact lens patients are therefore assumed to be indicative of an aberration or defect within the optical system.

Literature to date seems to indicate that the wear of soft contact lenses does indeed affect the contrast sensitivity function.[21-25] For the most part however, these studies are characterized by an insufficiency of subjects, a lack of controls, and an over-interpretation and over-generalization of the findings. At present, no attempt has been successful in explaining the causitive agent of the effect on contrast sensitivity.

SIGNIFICANCE

Information from a study which not only establishes correlation between the CSF and soft contact lens wear, but which also indicates that aspect of the optical system (contact lens or cornea) responsible for these changes, is essential in the initial approach to this problem. Once this has been accomplished the results will be two-fold. First, the direction of future studies will be more clearly defined, and second, the contact lens practitioner will gain needed insight into this common and confusing problem.

Due to the former complexities of the required apparatus and test procedure, contrast sensitivity testing had been limited solely to the research laboratory. Emerging interest in CSF as a clinical tool for eye care practitioners is spurred, however, by the recent availability of more simplified testing procedures. These are the CS2000 Contrast Sensitivity Testing System (available through Nicolet Biomedical Instruments), the Cadwell CTS 5000 (available through Cadwell Laboratories) and the Arden Photographic Plates (available from American Optical Co.). In light of these new capabilities and armed with the information provided by this study, the contact lens practitioner could facilitate the diagnosis and treatment of visual dysfunctions induced by soft contact lenses.

REVIEW OF THE LITERATURE

Based on a study comparing visual acuity in both hard and soft contact lens wearers, Wechsler predicts that approximately 25% of this population will show a decrease in measured acuity even when refractive error is completely corrected.[26] This determination was made by comparing best spectacle acuity with that measured with the contact lenses plus over-refraction. Another interesting finding revealed in this study was that the decrease in visual acuity of soft contact lens wearers is usually greater than that of hard lens wearers.

Possible explanations for this phenomenon are many. Often a decrease in acuity can be explained by the clinical observation that the contact lens surface for both hard and soft lenses is poorer than the normal corneal surface. Westheimer, however, has written that spherical aberration is the most important aberration in contact lenses.[27] Bauer has recently demonstrated that a soft contact lens having spherical surfaces produces significant longitudinal spherical aberrations as compared to spectacle lens aberrations.[28] He has suggested that soft contact lenses having at least one properly selected aspherical surface could be designed and made to correct for longitudinal spherical aberrations as compared to spectacle lens aberrations. Following this reasoning, it is possible, depending upon the topography of the individual cornea, that the retinal image may be enhanced or degraded by the contact lens.[26]

Millodot has described the effect of luminance reduction on contact lens wearers.[29] He notes, "...that the visual acuity of myopic subjects deteriorates more rapidly with contact lenses than with glasses as luminance decreases." The effects, therefore, of luminance reduction, spherical aberration, and lens surface defects may individually or in combination be held responsible for a decrease in visual function as related to soft contact lens wear.

An alternative, worthy of consideration in decreased visual function, is the contribution of the cornea. Using tests of contrast sensitivity, visual loss has been demonstrated to result from both corneal distortion and edema.[10,11] Thus the practitioner should be aware that a decrease in visual function can occur for any of the following reasons: 1) the inherent qualities of the contact lens, i.e. wettability, surface defects or deposits, aberrations, luminance reduction, etc., 2) corneal changes induced by the contact lens, or 3) a combination of both 1 and 2.

Contrast sensitivity functions are believed to provide a more definitive evaluation of visual performance with soft contact lenses than that already provided through conventional clinical procedures.[22] This is particularly true when compared to visual performance as currently determined through use of high contrast high spatial frequency standard acuity measurements.

Early studies demonstrated a positive correlation between soft contact lens wear and decreased contrast sensitivity function.[22,25] These studies emphasize that decreases in CSF, although minimal for high spatial frequencies, are most evident for the intermediate spatial frequency range of 2 to 4 cycles/degree. Differences between the two functions (spectacle lens versus contact lens) are demonstrated to be consistently greater for wearers of soft lenses when compared to those of hard lenses.[22] The resultant poorer vision with contact lenses is also demonstrated as neither measurable through use of conventional assessment methods nor correctable through refractive means. These results seem to confirm the impressions of some contact lens wearers that they do not see as clearly with their contact lenses as they do with their spectacles.

These studies have, however, been criticized for 1) failing to take residual astigmatism into account (uncorrected astigmatism can decrease contrast sensitivity), 2) failing to use inferential tests to evaluate the statistical significance of differences between type of correction (glasses versus contact lenses), and 3) generalizing from small numbers of subjects.[23]

Through studies into the moderately prolonged wear of soft contact lenses, others have found little evidence in support of visual degradation induced by soft contact lenses.[23] However, in a recent study by Mitra and Lamberts, contrast sensitivity for all twelve subjects tested was less with soft lenses than with spectacles and when retested after two weeks of soft lens wear, the CSF had decreased even more.[24] Statistical analysis of their data demonstrated a significant difference in contrast sensitivity when wearing soft lenses as opposed to spectacles. A significant drop in contrast sensitivity was also demonstrated by this study for subjects with no residual astigmatism while wearing soft lenses.

In summary, existing literature strongly suggests that the wearing of soft contact lenses does, in fact, result in a decrease in CSF for some but not all patients. However, to date, the writer has found no published work successful in explaining the etiology of this induced effect.

STATEMENT OF THE PROBLEM

The proposed study is concerned not only with the correlation between possible changes in contrast sensitivity and soft contact lens wear, but also with the particular aspect of the optical system (contact lens or cornea) responsible for this effect. The question is: "Does contrast sensitivity tell us more about a soft contact lens wearer's vision than Snellen acuity?"

The hypotheses are two in number; first, that contrast sensitivity for a group of patients recently fit with soft contact lenses will not be reduced, when compared to prefit CSF with spectacles. Second, if the first null hypothesis is rejected, that for soft lens patients showing a significant decrease in contrast sensitivity, responsibility for this decrease can be ascribed to either the cornea, or the contact lens, or to the cornea and contact lens in combination. For these patients immediate contact lens removal should demonstrate one of three different situations: (1) no significant change in the observed contrast sensitivity, indicating changes in the cornea as chiefly responsible for the decrease in CSF; (2) an increase in contrast sensitivity to a level not significantly different from that measured with spectacles before fitting the contact lenses, isolating the soft contact lens as primarily responsible for the change in CSF; (3) an increase in contrast sensitivity approaching but still significantly lower than prefit levels as measured with glasses, indicating a shared relationship by both contact lens and cornea for a decreased CSF.

The first (null) hypothesis will be rejected if there is a significant decrease in contrast sensitivity for any of the spatial frequencies tested when contact lenses are worn. It will be accepted if a significant decrease does not occur.

Rejection of the first (null) hypothesis will lead to consideration of the second three step hypothesis. Step I of the second hypothesis will be accepted if no significant change in contrast sensitivity occurs once the contact lenses are removed; it will be rejected, however, if a significant change does occur. Rejection of Step I would lead to consideration of Steps II and III of this hypothesis. Step II of the second hypothesis will be accepted if the change in contrast sensitivity is not significantly different from that measured with spectacles before fitting the contact lenses. Its rejection would logically lead to the acceptance of Step III of this hypothesis.

SUBJECTS

Nineteen subjects (38 eyes) were utilized for this study. The subjects were selected among optometry students, and clinic patients of Pacific University College of Optometry. All subjects were potential wearers of contact lenses and were examined, fit, and followed by senior interns at the College of Optometry at Pacific University.

The experimental group was selected according to the following criteria: (1) visual acuity correctable to 20/20 or better with best spectacle correction (this correction was utilized for all pre- and post-contact lens wear testing), (2) age ranging from 15 to 35 years (this range was chosen to avoid such problems as poor comprehension of test procedures, age related effects on CSF,[2,7,18] and presbyopia), (3) refractive error limited to the spherical range of +3.00 to -6.00 diopters inclusively (this range was chosen to eliminate the effects of high refractive error upon CSF,[8,9] (4) Snellen acuity of 20/20 or better with contact lenses,* (5) no active or inactive pathology (systemic or ocular), (6) clear media in both eyes, and (7) pupils greater than 3 mm in diameter.[5] Details of the patient population, including their age, refraction, soft lens prescription, and acuities are presented in Table 1 (pages 10-13).

* Normally this precludes residual astigmatism from exceeding 0.75 diopters. Measured amounts of residual astigmatism and/or sphere were corrected during testing using a trial frame and lenses.

Table I: Data Describing the Patient Population*

Patient	Age	Refraction	Soft Lens	Over-Refraction	Snellen Acuity: Glasses**	Snellen Acuity: Soft Lens + Over-Refraction***
1	15	OD -2.50 -0.50 x 090	-2.75 CSI	plano	20/15	$20/15^{-2}$
		OS -2.50 -0.25 x 085	-2.75 CSI	plano	20/15	$20/15^{-2}$
2	32	OD +3.00 -0.50 x 090	+4.00 CSI	-0.50 sph	$20/15^{-1}$	$20/20^{+1}$
		OS +2.50 -0.25 x 090	+3.25 CSI	-0.50 sph	$20/20^{+3}$	20/20
3	23	OD -1.50 -0.50 x 160	-1.25 Durasoft II	pl -0.50 x 135	20/15	$20/15^{-1}$
		OS -1.25 -0.50 x 096	-1.25 Durasoft II	pl -0.50 x 030	20/15	$20/15^{-2}$
4	25	OD -1.50 -0.25 x 048	-1.75 CSI	-0.25 sph	$20/15^{-1}$	$20/20^{+3}$
		OS -1.75 sph	-1.75 CSI	-0.25 sph	$20/15^{-1}$	$20/20^{+3}$
5	23	OD -1.50	-2.00 Hydron "06"	plano	$20/15^{-1}$	20/15
		OS -1.75 -0.25 x 180	-2.00 Hydron "06"	+0.25 sph	20/15	20/15

Table I: *Data Describing the Patient Population**
(Continued)

Patient	Age	Refraction	Soft Lens	Over-Refraction	Snellen Acuity: Glasses**	Snellen Acuity: Soft Lens + Over-Refraction***
6	38	OD -2.00 sph	-2.00 CSI	plano	$20/15^{-1}$	$20/15^{-2}$
		OS -1.25 sph	-1.25 CSI	plano	$20/15^{-1}$	$20/15^{-2}$
7	34	OD -2.50 -0.50 x 150	-2.50 Hydrocurve II	+0.25 -0.50 x 150	20/15	$20/20^{3}$
		OS -2.50 -0.50 x 030	-2.50 Hydrocurve II	+0.25 -0.50 x 035	20/15	$20/20^{+}$
8	35	OD -4.75 sph	-4.75 Hydrocurve II	plano	$20/20^{+2}$	$20/15^{-2}$
		OS -4.25 -0.50 x 002	-4.50 Hydrocurve II	plano	$20/20^{+3}$	$20/15^{-2}$
9	23	OD -2.25 sph	-2.25 Hydrocurve II	plano	20/15	20/15
		OS -2.25 -0.25 x 100	-2.25 Hydrocurve II	plano	20/15	20/15
10	24	OD -6.50 -0.50 x 035	-6.00 B&L, "U-4"	plano	20/15	$20/15^{-2}$
		OS -6.50 -0.50 x 075	-6.00 B&L, "U-4"	plano	20/15	$20/15^{-2}$

Table I: Data Describing the Patient Population*
(Continued)

Patient	Age	Refraction	Soft Lens	Over-Refraction	Snellen Acuity: Glasses**	Snellen Acuity: Soft Lens + Over-Refraction***
11	28	OD -1.00 -0.75 x 030	-1.25 Hydrocurve	pl - 0.75 x 030	$20/15^{-1}$	$20/15^{-2}$
		OS -3.00 -0.50 x 132	-3.25 Hydrocurve	pl - 0.50 x 100	$20/15^{-1}$	$20/15^{-3}$
12	23	OD -2.25 sph	-2.50 Hydrocurve II	plano	20/15	20/15
		OS -1.50 -0.50 x 180	-1.75 Hydrocurve II	plano	20/15	20/15
13	25	OD -2.25 sph	-2.25 Hydrocurve II	plano	20/15	20/15
		OS -2.25 sph	-2.25 Hydrocurve II	plano	20/15	20/15
14	27	OD -2.00 sph	-2.25 Hydrocurve	plano	20/15	20/15
		OS -2.25 sph	-2.25 Hydrocurve	plano	20/15	$20/20^{+3}$
15	36	OD -1.75 sph	-1.25 Hydrocurve II	-0.25 sph	$20/15^{-2}$	$20/15^{-1}$
		OS -1.50 sph	-1.00 Hydrocurve II	plano	$20/15^{-2}$	$20/15^{-2}$

Table I: Data Describing the Patient Population*
(Continued)

Patient	Age	Refraction	Soft Lens	Over-Refraction	Snellen Acuity	
					Glasses**	Soft Lens + Over-Refraction***
16	22	OD +0.50 sph	+0.50 Hydrocurve II	-0.25	20/15	20/15
		OS +0.75 -0.25 x 083	+0.75 Hydrocurve II	plano	20/15	20/15
17	24	OD -4.25 sph	-4.50 Hydrocurve II	plano	20/15	20/15
		OS -4.50 sph	-4.25 Hydrocurve II	-0.25	20/15	20/15
18	26	OD -2.25 -0.25 x 180	-2.25 Hydrocurve	plano	20/15	$20/15^{-1}$
		OS -2.25 -0.25 x 172	-2.25 Hydrocurve	plano	20/15	20/15
19	23	OD -4.50 sph	-4.50 B&L, "U-4"	plano	20/15	20/15
		OS -4.50 sph	-4.75 B&L, "U-4"	plano	20/15	$20/15^{-1}$

* See Appendix I
** Baseline measurement
*** Pre-data collection at last evaluation (one month)

MATERIALS AND METHODS

The instrument used in this study was the Nicolet Optronics CS-2000 Contrast Sensitivity Testing System.[30] The CS-2000 is a new instrument recently introduced to the health care field. It's appearance is one of a desk top microcomputer consisting of a console (keyboard display and printer), a large display screen (size of a small portable TV), and an observer response box (Figure 1). It also has a built-in calibration system which limits the need for external photometric calibration. This feature ensures standard testing conditions between patients. However, since the sensitivity values provided by the CS-2000 are arbitrary, the instrument was photometrically calibrated prior to testing. This enables comparison of data from this instrument with that of other instruments.

The CS-2000 can be programmed to electronically generate stationary, flickering, or drifting sine wave grating targets at various levels of contrast, spatial frequency, and mean luminance (Figure 2). The gratings appear on the display monitor at a specific mean luminance. Through a preprogrammed memory this instrument also provides four possible psychophysical techniques for test administration. The observer response box allows the subject to signal when a pattern is first detected. This is accomplished either by pressing a button or by adjusting grating contrast until it is just visible. This allows measurement of relationships between contrast sensitivity and spatial frequency for gratings which have a sinusoidal luminance profile. Monocular testing of both eyes requires approximately 20 minutes.

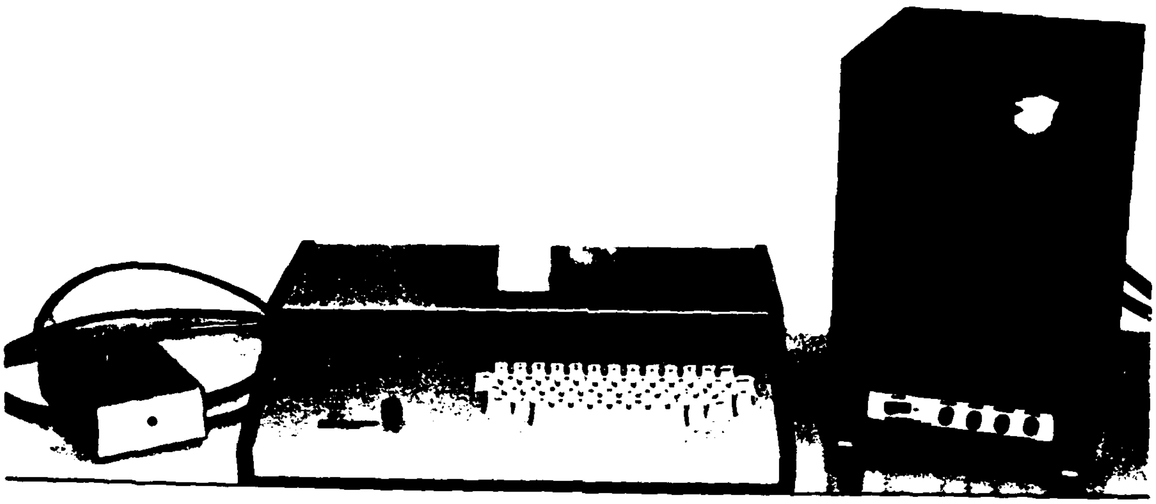


Figure 1. The CS-2000 Contrast Sensitivity Testing System.

From left to right: observer response box, control console with keyboard, and contrast sensitivity display monitor.

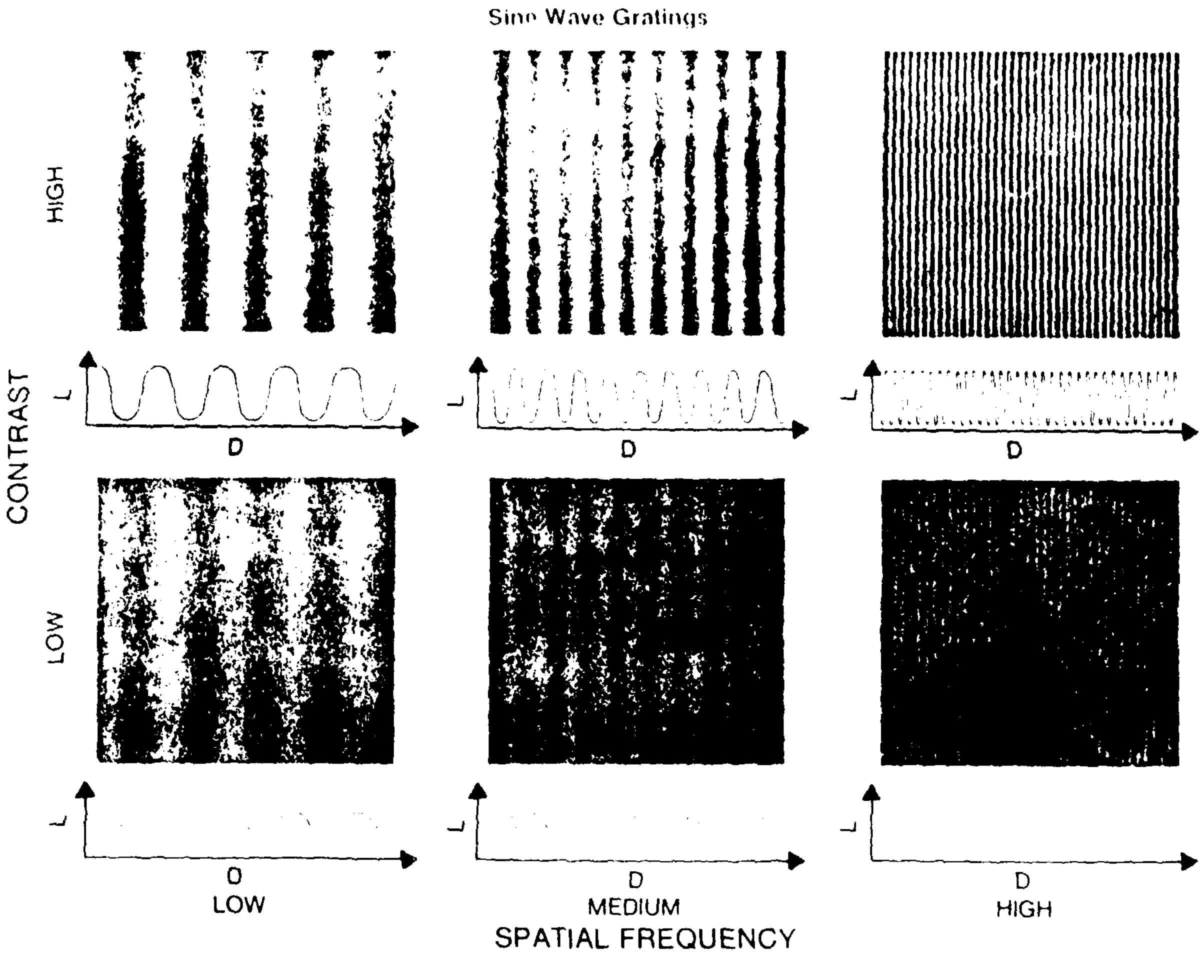


Figure 2. Examples of Sine Wave Gratings[31]

At a testing distance of 3 meters the display monitor, measuring 22.5 centimeters horizontally and 28.5 centimeters vertically, subtends a visual angle of 4.3 deg horizontally by 5.4 deg vertically at the eye of the observer. With proper adjustment of the display monitor some shimmer of the raster lines was noted by subjects at close viewing distances, e.g. approximately one meter. From the standard viewing distance (3 meters), the display appeared as a bright, homogeneous field.

Uniformity of peripheral and central fields was provided by a mask surrounding the display monitor (Figure 3). Due to subject complaints during pre-trial studies regarding large brightness differences between monitor and surround in a non-illuminated room some modifications were necessary. A 40 watt incandescent bulb was located above the monitor and behind the mask to provide a low level of indirect background illumination. Its location behind the mask avoided complications, e.g. screen reflection, which might have resulted from use of an alternate location.

The CS-2000 may be calibrated using any one of three methods: (1) Standard Method - This semi-automatic method of calibration is designed to keep the instrument set for proper contrast and luminance values over time. Proper use of this method assures that the display monitor when measured at screen center is set for 100 candela per square meter average luminance, and 0.50 peak contrast. (2) Photometric Method - This method allows the operator to adjust the display to a specified mean luminance and contrast, and to verify that the display behaves in a linear fashion at these settings. (3) Non-Standard Method - This third method allows the CS-2000 to "scan" the display monitor after it has been calibrated to some non-standard luminance and contrast. The display monitor may then be set to those

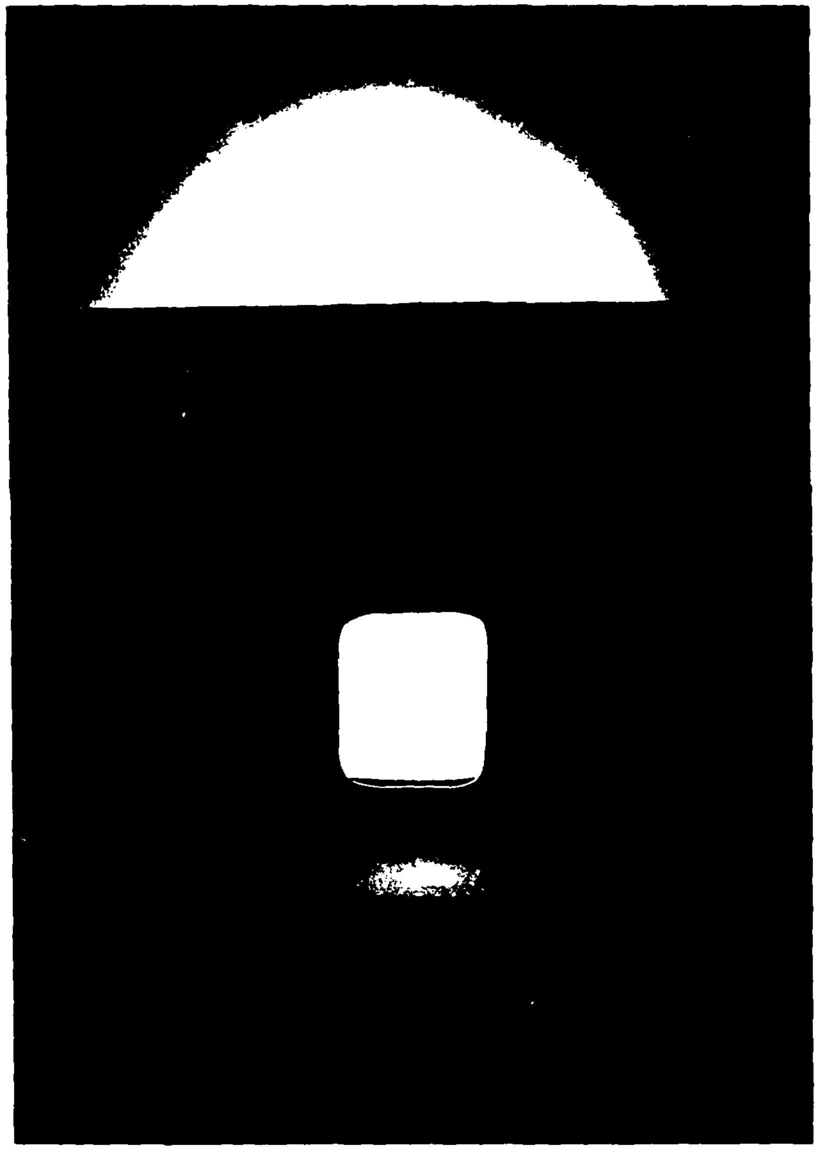


Figure 3. Display Monitor and White Poster Board Surround

same values using the "standard method" calibration routine.

After final establishment of the testing environment, i.e. instrument modifications, lighting, patient position, etc., the "standard method" was used to calibrate the CS-2000. Following this a Tektronix J-16 Photometer with J6523 luminance probe (1 deg measuring circle) was used in combination with the "photometric method" of calibration to verify the luminance and contrast settings established by the "standard method". Peak contrast was measured at 0.546, a 6.2% difference from the expected value 0.50 (see Appendix A for details). Error analysis for calibration drift based on interval variance within the $\pm 5\%$ limit was also determined (Appendix B). This information was used at the end of each data collection period to assure that instrument calibration had remained within a predetermined tolerance range of $\pm 5\%$ during testing for a given period of time.

With calibration complete, the average luminance, based on 13 measurements, for the featureless screen was measured at 93 candela/meter^2 (see Appendix C for details). Eight measurements were used to evaluate the screen border. The average luminance was found to be 1.59 candela/meter^2; maximum deviation from mean luminance was 38.4% (see Appendix D). This deviation was explained by screen reflection from the table surface upon which both the display monitor and surround were resting (Figure 3). Lastly, the ambient illuminance at the subject's entrance pupil (3 meters from screen) for all testing was measured using a Tektronix J-16 Photometer with J6511 illuminance probe at 4.7 lux (lumens/meter^2).

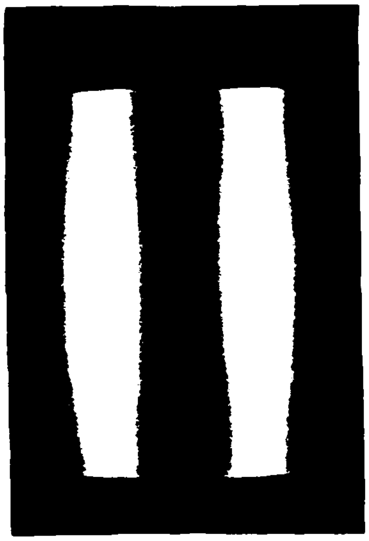
Through design, programming of the CS-2000 for testing has been facilitated by grouping all non-standard test options into three general categories. These are as follows: (1) Setup - the selection and configuration of apparatus, i.e. test distance, screen size, line rate, and peak contrast, (2) Method - the psychophysical technique employed, i.e. Von Bekesy tracking method, visual evoked response mode, method of adjustment, and method of increasing contrasts, and (3) Stimuli - the pattern presented during testing, i.e. number, type (static, moving, counterphase, full-field flicker, and intermixed), grating vs. bar, and contrast. The final format determined for this study is described below (Apppendix E).

The standard "Set-Up" option was used for all testing. This allowed for a viewing distance of three meters which is strongly recommended by the manufacturer for the following reasons: (1) large display angular subtense, (2) ease of viewing even for observers who have difficulty accomodating, and (3) elimination of the problems that may accompany close viewing of any modulated-raster display. This option assumes that the CS-2000 display monitor alone will be used at a pre-programmed peak contrast of 0.5. Contrast values above 0.6 will influence monitor linearity and must be compensated for.

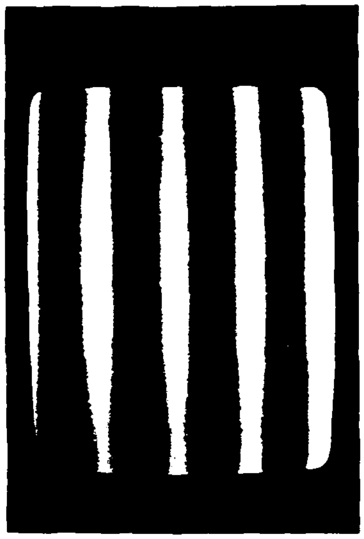
The psychophysical "Method" chosen for this study was that of increasing contrasts (ascending limits), i.e. the contrast of the light and dark bars is raised until the subject is just able to detect the grating.[32] A preview of each stimulus pattern was also provided. Total preview time (including two-second plateau time plus the minimum time needed for on-and off-ramps) was four seconds. The standard preview contrast of 0.5 was decreased to 0.2. This reduction was essential to the elimination of preview afterimages which might interfere with subjects' responses. Full scale time or the time the CS-2000 will take to change pattern contrast from zero to full contrast was an important consideration. When full scale time is low, contrast changes quickly and observer reaction time becomes more significant. This will interfere with proper interpretation of the data. At the other extreme high values result in observer impatience which might lead to unreliable responses. After careful consideration of all project parameters, including subject criteria, the manufacturer's recommended value of 30 seconds was decided upon. The instrument was programmed to repeat the test grating four times in succession to obtain an average contrast threshold for each spatial frequency.

The "Stimuli" format consisted of eight separate trials, each of which presented a single static sinusoidal grating. The first two trials, which presented gratings of 1.0 and 6.0 cycles/degree, were used to provide practice for the observer. The remaining six, representing 0.5, 1.0, 3.0, 6.0, 11.4, and 22.8 cycle/degree gratings presented in random order, were data-collection trials (Figure 4). The top of the range from which the starting contrast was to be randomly selected was specified as 0.001. Initial pattern presentation would therefore occur at some randomly chosen point between 0 and 0.001. A trial repeat would automatically re-randomize the starting contrast. Through use of standard instrument provisions, trials were aborted and/or repeated and new stimuli added at the option of the operator.

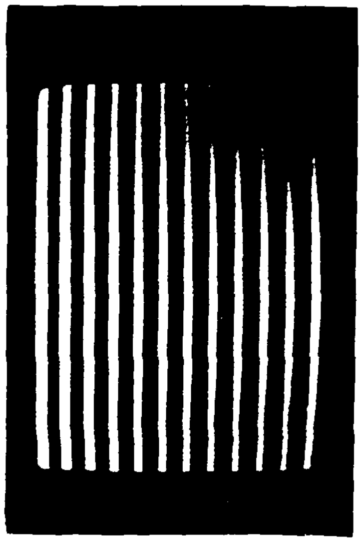
Prior to the experimental procedure instrument reliability testing was performed for the CS-2000 (see Appendix F for details). Nine randomly chosen subjects (18 eyes) were chosen for the study; repeat testing did not occur sooner than two days or longer than five days following the initial test. Pearson's Product Moment Correlation Coefficients (r) were determined for each of the six spatial frequencies to be used in the primary



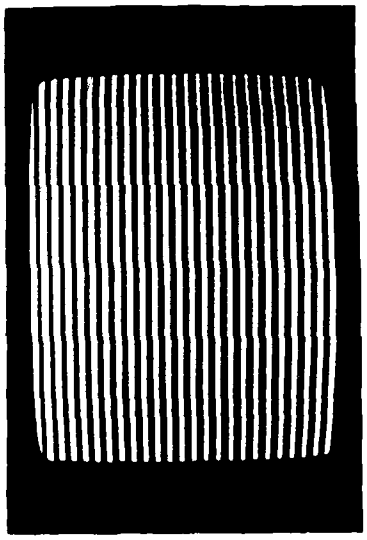
0.5 Cycles/Degree



1.0 Cycles/Degree



3.0 Cycles/Degree



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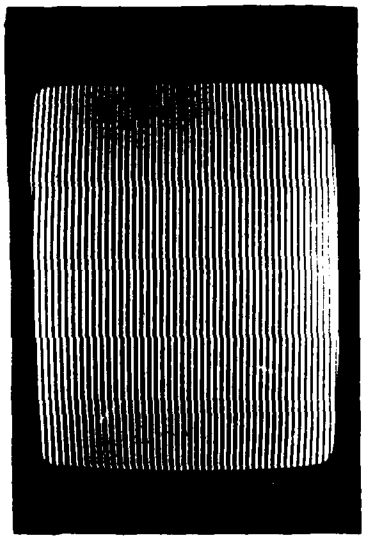
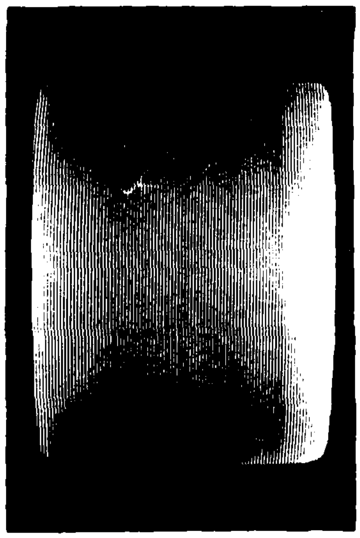


11.[illegible] Cycles/Degree



[illegible].5 Cycles/Degree

Figure 4: Spatial Frequencies Used to Determine Contrast Sensitivity Function (CSF)

study. The spatial frequency of 0.5 cycles per degree was found to have the lowest correlation value (r=.777), while 3.0 cycles/degree was found to have the highest (r=.949). All "r" values were statistically significant at the 0.001 level.

On the day of the actual experimental procedure, but prior to conducting the trial, aided visual acuity was measured for each subject using Snellen letters. Pupillary diameters were also recorded. The subject was then seated at the fixed distance of three meters from the CS-2000 display monitor; this distance remained constant for all subsequent testing.

Prior to contact lens fitting, contrast sensitivity for the six preselected spatial frequencies, ranging from 0.5 cycles per degree to 22.8 cycles per degree, was determined monocularly for each patient while glasses were worn (Baseline Data). Immediately following fitting, this testing was repeated, not occurring however, sooner than 30 minutes or longer than 60 minutes following the fitting of the soft lens (Dispensing Data). Measured amounts of residual astigmatism and/or sphere were corrected during testing using a trial frame and lenses. Once completed, the contact lenses were removed and testing redone for each eye. Similarly, before and after testing was done at both one and four weeks following the initial fitting. On these occasions and immediately prior to testing, all subjects were to have worn their contact lenses continuously for no less than four hours and no more than eight.

TREATMENT OF DATA

The aim of the first portion of this study was to determine whether or not the wear of soft contact lenses would significantly reduce any portion of the prefit contrast sensitivity function for the 38 eyes (19 subjects) tested. Six unidirectional "t" tests (for related measures), one for each spatial frequency, were used to compare prefit contrast sensitivity data (baseline) with that when contact lenses were worn and residual error was corrected (collected at dispensing, one week following dispensing, and one month following dispensing). Results are considered significant if there is less than one percent probability of obtaining a calculated "t" value by random factors alone ($P<0.01$).[34] However, if the probability is between one and five percent ($0.01<P<0.05$) the results are considered probably significant.[35] Significance, in this context, means that contrast sensitivity is changed (lowered) with contact lenses when compared to that with spectacles; e.g., when the level of significance is 0.01, there is only a one percent chance of obtaining the observed decrease in contrast sensitivity by random factors alone.

If a decrease for any spatial frequency was found to be statistically significant, those subjects demonstrating a clinically significant decrease in contrast sensitivity for that frequency (one standard deviation from the mean contrast sensitivity with spectacles) were further evaluated. A unidirectional "t" test for related measures was used to determine responsibility for this loss. Contrast sensitivity data with the contact lens on was compared to that just after the contact lens was removed. A significant (as defined in the previous paragraph) increase in contrast sensitivity would not only reject Step I of the second hypothesis, i.e. the cornea being chiefly responsible for the decrease in contrast sensitivity, but would require further consideration of Steps II and III. If the results of this comparison were not significant Step I was accepted and consideration of the remaining steps was unnecessary.

Assuming rejection of Step I, a unidirectional "t" test (post contact lens wear-prefit) would then be necessary. If the difference here is not significant, Step II of the hypothesis, i.e. the contact lens being chiefly responsible for the decrease in contrast sensitivity, is accepted. A significant difference however, would logically lead to a rejection of Step II and subsequent acceptance of Step III. This would then indicate a shared relationship by both the contact lens and cornea for a decreased contrast sensitivity.

Since each spatial frequency was tested for change at three different times, part of the data analysis probed the effects of successive experimental manipulations (dispensing, one week, one month). The statistical procedure used for this purpose was adapted from a "Treatment by Subjects" (repeated measures) design.[33] This design is also known as a "Single Factor Analysis of Variance" (code name SANVAR), on file at the Pacific University College of Optometry Computer Center (see Appendix G). The experimental group was evaluated by SANVAR using the three contrast sensitivity values, one for each point in time, as the repeated measures for each subject.

The SANVAR calculation produces a F ratio which is used to estimate the probability of random occurrence of the experimental results. Results are considered significant if there is less than one percent probability of obtaining a calculated F by random factors alone ($P<0.01$).[34] However, if the probability is between one and five percent ($0.01<P<0.05$) the results are considered <u>probably</u> significant.[35] Significance, in the present context, means nonrandom variation (instability between treatments) in contrast sensitivity measures over time.

RESULTS

Relative to the first hypothesis data analysis performed with the "t" test (Appendix H) is demonstrated in Table II. The value "t" for all but the highest (22.8 cycles/degree) and lowest (0.5 cycles/degree) spatial frequencies tested was found to be statistically insignificant. The "baseline-dispensing" "t" value (t=-1.807) for 0.5 cycles/degree is significant between the 0.05 and 0.025 level. This indicates a probably significant increase in contrast sensitivity for those newly fit contact lens wearers at a spatial frequency of 0.5 C/D. The probability of the calculated "t" value occurring by chance is between five and two and one-half times in one hundred.

The "baseline-dispensing" "t" value (t = 2.349) for 22.8 cycles/degree, the highest spatial frequency tested, is significant between the 0.025 and the 0.01 level. This indicates that the probability of the calculated "t" value occurring by chance is between two and one-half and one times in one hundred. The remaining "t" values for this same frequency, "baseline-one week" (t = 3.390) and "baseline-one month" (t = 3.905) are statistically significant below the 0.005 level. This indicates the probability of these "t" values occurring by chance is less than five times in a thousand and five times in ten thousand respectively. It is thus concluded that measured contrast sensitivity with contact lenses (residual error corrected) is significantly lower when compared to that measured with spectacles for only the highest (22.8 cycles/degree) of the spatial frequencies measured. This decrease is graphically demonstrated using the mean contrast sensitivity values in Table III (See Figure 5).

Table II: Significance study (unidirectional "t" test for related measures*) comparing contrast sensitivity data. Data taken with contact lenses (residual error corrected) at dispensing, one week, and one month are compared to that taken with spectacles before contact lens fitting (baseline data).

SPATIAL FREQUENCY		DISPENSING	ONE WEEK	ONE MONTH
0.5 C/D	"t" value	-1.807	-.927	-.918
	Significance Test**	Probably Significant $P < .05$	Not Significant $P < .25$	Not Significant $P < .25$
1.0 C/D	"t" value	-.155	-.296	-.344
	Significance Test**	Not Significant $P < .25$	Not Significant $P < .25$	Not Significant $P < .25$
3.0 C/D	"t" value	-.888	-.861	-.693
	Significance Test**	Not Significant $P < .25$	Not Significant $P < .25$	Not Significant $P < .25$
6.0 C/D	"t" value	.316	.018	-.117
	Significance Test**	Not Significant $P < .25$	Not Significant $P < .25$	Not Significant $P < .25$
11.4 C/D	"t" value	.152	-.697	.044
	Significance Test**	Not Significant $P < .25$	Not Significant $P < .25$	Not Significant $P < .25$
22.8 C/D	"t" value	2.349	3.390	3.905
	Significance Test**	Probably Significant $P < .025$	Highly Significant $P < .005$	Highly Significant $P < .0005$

* See Appendix H

** N = 38 eyes (19 subjects)

Table III: Mean contrast sensitivity* (±1 standard deviation) with spectacle or soft contact lens correction.

SPATIAL FREQUENCY IN CYCLES PER DEGREE	CONTRAST SENSITIVITY			
	SPECTACLES	SOFT CONTACT LENS**		
	BASELINE	DISPENSING	ONE WEEK	ONE MONTH
0.5	25.5 ± 12.1	29.4 ± 17.8	27.0 ± 13.2	27.3 ± 15.6
1.0	59.4 ± 20.8	59.8 ± 22.4	60.4 ± 23.1	58.3 ± 23.6
3.0	122.5 ± 35.5	127.5 ± 34.5	126.7 ± 29	126.3 ± 34.1
6.0	111.7 ± 37.5	109.8 ± 34.8	111.6 ± 32.6	112.4 ± 35
11.4	61.3 ± 23.7	60.7 ± 24.8	64.0 ± 24.1	61.1 ± 22
22.8	27.9 ± 12.4	24.1 ± 12.3	22.6 ± 10.1	21.8 ± 9.7

* N = 38 eyes (19 subjects)
** Residual error corrected

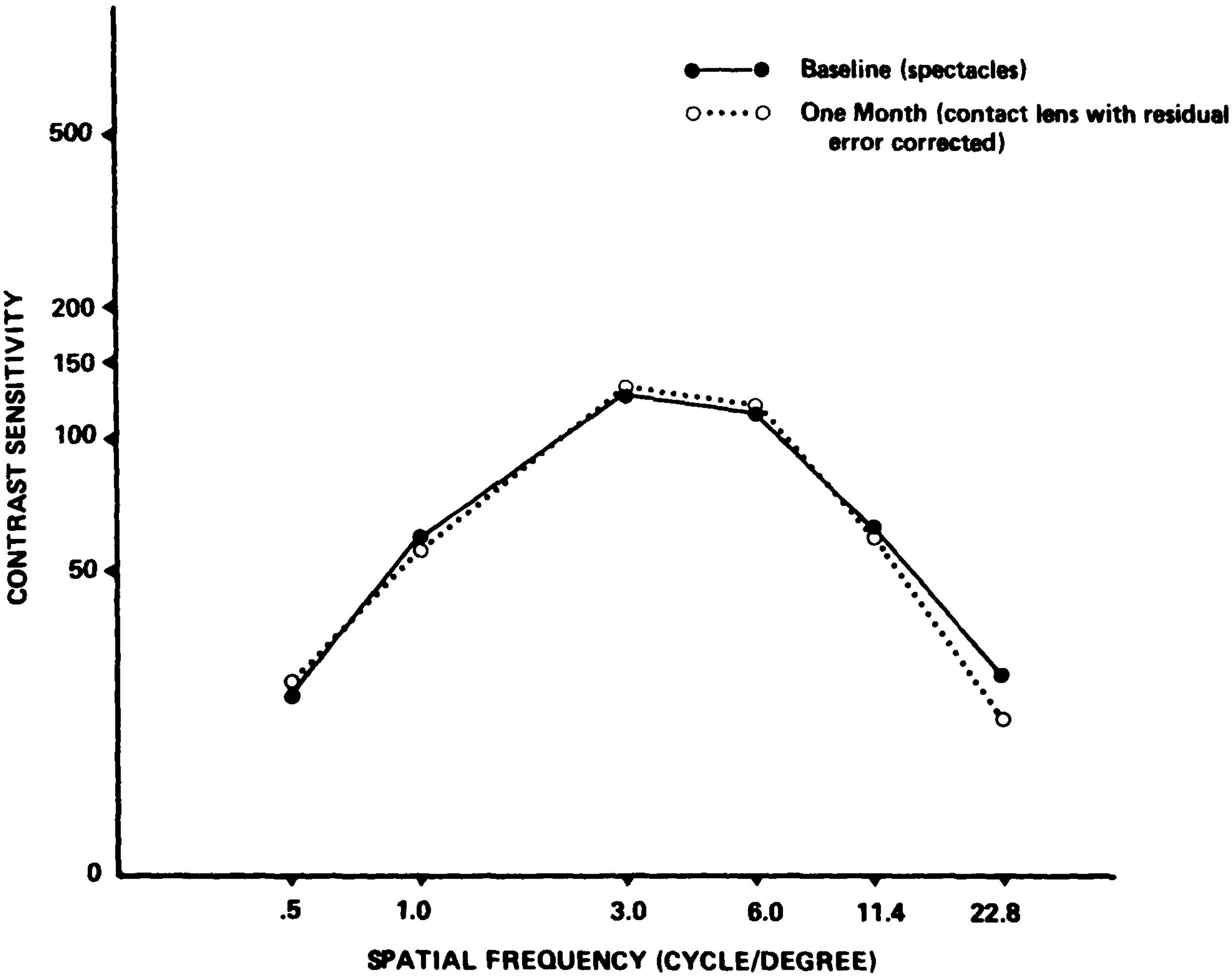


Figure 5. Graph of Contrast Sensitivity Function (CSF). Mean contrast sensitivity is plotted as a function of cycles/degree. This is referred to as contrast sensitivity function (CSF). Graph above compares baseline CSF (measured with spectacles) to that measured after one month of soft contact lens wear (measured with residual error corrected). Data taken from Table III, page 29.

For those eyes demonstrating a clinically significant decrease in contrast sensitivity (one standard deviation from the mean contrast sensitivity with spectacles) further comparisons are made (see Table IV). Data taken with the contact lenses are compared to that taken immediately following contact lens removal. Comparisons are made for data collected at dispensing, one week, and one month. All "t" values are statistically significant at the 0.005 level, indicating the probability of these "t" values occurring by chance is less than five times in a thousand. It is thus concluded that measured contrast sensitivity immediately following contact lens removal is significantly higher than that measured with the contact lens (residual error corrected). This not only rejects Step I of the second hypothesis but also requires consideration of Steps II and III.

Data taken immediately following contact lens removal is compared to that taken with spectacles before contact lens fitting (baseline) (see Table V). All "t" values show significance with that at one month demonstrating the highest significance ($P<0.01$). It is thus concluded that although significantly elevated following contact lens removal, contrast sensitivity values for these eyes are statistically different (lower) than prefit baseline data.

Supplemental SANVAR analysis of the data for each spatial frequency yielded the following:

0.5 C/D	$F = 1.09$
1.0 C/D	$F = 0.40$
3.0 C/D	$F = 0.04$
6.0 C/D	$F = 0.16$

11.4 C/D	F = 0.69
22.8 C/D	F = 1.53

All F values would occur more often than 20 percent of the time through random factors alone (P>0.20).* It is, thus, concluded that the measured contrast sensitivity values were stable over the range of testing sessions used in this study.

* Critical F ratio for df_1/df_2 of 2/74 is 1.65 at the twenty percent level of significance.

Table IV: Significance study (unidirectional "t" test for related measures) comparing contrast sensitivity data for eyes demonstrating a clinically significant decrease in contrast sensitivity. Data taken with contact lenses (residual error corrected) at dispensing, one week, and one month are compared to that taken immediately following contact lens removal.

SPATIAL FREQUENCY		DISPENSING	ONE WEEK	ONE MONTH
22.8 C/D	"t" value	3.981	3.599	[illegible].619
	Significance Test	Highly Significant* P < .005	Highly Significant** P < .005	Highly Significant*** P < .005

* N = 16 eyes
** N = 19 eyes
*** N = 19 eyes

Table V: Significance study (unidirectional "t" test for related measures) comparing contrast sensitivty data for eyes demonstrating a clinically significant decrease in contrast sensitivity. Data taken immediately following contact lens removal at dispensing, one week, and one month are compared to that taken with spectacles before contact lens fitting (baseline data).

SPATIAL FREQUENCY		DISPENSING	ONE WEEK	ONE MONTH
22.8 C/D	"t" value	2.358	2.238	2.602
	Significance Test	Probably Significant* $P < .025$	Probably Significant** $P < .025$	Probably Significant*** $P < .01$

* N = 16 eyes
** N = 19 eyes
*** N = 19 eyes

DISCUSSION AND CONCLUSION

The objective of this study was to investigate the correlation between changes in contrast sensitivity before and after soft contact lens wear. The overall question was: "Does contrast sensitivity tell us more about a soft contact lens wearer's vision than Snellen acuity?"

The research questions were as follows: (1) Is contrast sensitivity for a group of patients recently fit with soft contact lenses reduced, when compared to prefit CSF with spectacles? (2) If, in fact, a significant decrease in contrast sensitivity occurs, can this be ascribed to (a) the cornea alone, (b) the contact lens alone, or (c) the cornea and contact lens in combination?

To examine these questions, measurements of contrast sensitivity for six spatial frequencies ranging from 0.5 to 22.8 cycles/degree were taken before and after the wearing of the contact lenses. Measurements occurred at dispensing and subsequent to dispensing at intervals of one week and one month.

Based on the results of the "t" test (related measures) measured contrast sensitivity with contact lenses is significantly lower for only the highest of the six spatial frequencies measured (22.8 cycles/degree) when compared to that measured with spectacles. This decrease, ranging between 14 and 22 percent, was consistent for each testing session. Levels of significance ranged from 0.025 to 0.0005 depending on the time of lens wear measured from day of dispensing. It is noted, however, that most subjects experienced problems while responding to both the lowest (0.5 cycles/degree) and the highest (22.8 cycles/degree) spatial frequencies at the time of lens dispensing. The probably significant increase in contrast sensitivity for 0.5 cycles/degree measured at dispensing was not repeatable at subsequent test sessions and was probably due to poor lens adaptation. Thus, the first null hypothesis (H_o) is rejected.

For those eyes demonstrating a clinically significant decrease in contrast sensitivity for 22.8 cycles/degree further examination revealed: (1) sequential rejection of Steps I and II of the second null hypothesis (H_o), and (2) acceptance of Step III. The implication from this result is two fold: (1) decreased contrast sensitivity with contact lenses is elevated once again when the lenses are removed, and (2) after lens removal these elevated contrast sensitivity values fall short of prefit measurements within the time interval tested. Therefore, it is concluded that the etiology for decreased contrast sensitivity resulting from contact lens wear is shared by both the contact lens and the cornea. Step III of the second null hypothesis is therefore accepted.

Based on the results of the SANVAR analysis, it is also concluded that there is no significant variation of the measured contrast sensitivity values over the range of testing sessions used in this study. In other words, decreased contrast sensitivity during the wear of soft contact lenses did not fluctuate (increase or decrease) over the time evaluated.

In view of the literature and the results of this study, two facts were apparent. First, there is reason to question the literature which demonstrated large losses in contrast sensitivity with soft contact lens wear for the low and middle spatial frequency range. Second, when comparing the results of this study with the pre- and post- visual acuities found in Table I (pages 10-13) it is difficult to demonstrate quantitatively that contrast sensitivity does in fact tell us more about a soft contact lens wearer's vision than Snellen acuity. The fact that approximately one-half of the eyes used in this study showed a small, but measurable, loss in Snellen acuity with contact lens wear correlates well with contrast sensitivity losses for high spatial frequencies.

The conclusions of this study are as follows:

(1) CSF is lowered with soft contact lenses for only the highest spatial frequency tested (22.8 cycles/degree).

(2) Etiology for this decrease is shared by both the contact lens and the cornea.

(3) Measurement of CSF as a diagnostic tool in the fitting of soft contact lenses is not warranted. When compared to Snellen acuity, sufficient additional information is not provided.

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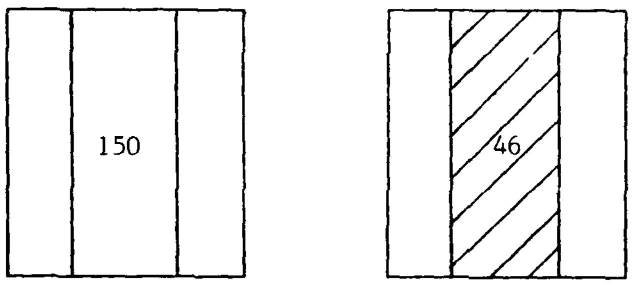
APPENDIX A

PHOTOMETRIC MEASUREMENT OF MONITOR DISPLAY (PEAK CONTRAST)

I. Photometric measurement of monitor display (peak contrast).

A. A Tektronix J-16 Photometer with J6523 luminance probe was used to measure the peak contrast of the monitor display. As described in the Nicolet CS-2000 Contrast Sensitivity Testing System Operation Manual, the "standard method" of calibration was used to set the display monitor for 100 candela per square meter average luminance, and 0.50 peak contrast (both measured at screen center).[30] All readings were taken under the same lighting conditions as used for testing.

B. Using the "photometric method" of calibration, two measurements were taken. Both readings were taken at the center of the screen using a 1 deg measuring circle. As demonstrated below, one measurement was for a predesignated "bright" bar which was programmed to appear in the center of the display monitor, the other for a "dark" bar.



Units of Measurement = nits ($candela/meter^2$)

C. Peak Contrast $= \dfrac{L_{max} - L_{min}}{L_{max} + L_{min}} = \dfrac{150 - 46}{150 + 46} = 0.531$

D. % Deviation from expected $= \dfrac{0.531 - 0.500}{0.500} \times 100 = 6.2\%$

APPENDIX B

"CALIBRATION DRIFT" ERROR ANALYSIS

I. "Calibration drift" error analysis

A. A more detailed understanding of the "standard method" of calibration is required by the reader to understand the following procedure. Each time this mode of calibration is used the instrument will internally monitor its own luminance for a few seconds. This completed, a message will appear indicating: (1) the display control (brightness or contrast) that is further from proper adjustment, (2) a sign, (+) or (-), indicating the direction in which to adjust the specified control, and (3) a number indicating the degree of maladjustment. For example, a reading of BRIGHTNESS (+6) indicates that: (1) the brightness control is further from proper adjustment, (2) this control must be adjusted in a clockwise direction (minus represents a counterclockwise direction), and (3) the degree of maladjustment is relatively low.

B. A Tektronix J-16 Photometer with J6523 luminance probe was used to measure the luminance of the monitor display. As described in the Nicolet CS-2000 Contrast Sensitivity Testing System Operation Manual, the "standard method" of calibration was used to set the display monitor for 100 candela per square meter average luminance, and 0.50 peak contrast (both measured at screen center).[30] All readings were taken under the same lighting conditions as used for testing. All readings were taken at the center of the screen using a 1 deg measuring circle.

C. A four step method used to analyze drift error.

(1) Calibrate the display monitor using the "standard method".

(2) Generate one "light" or one "dark" bar of light on the monitor using the "photometric method" of calibration (see Appendix A). Measure its luminance.

(3) While photometrically monitoring the luminance of the bar used in Step 2, adjust the luminance of the bar up or down by 5 percent. This is accomplished using either the brightness or contrast control.

(4) Repeat calibration using the standard method. The initial readout will indicate the required adjustment for the instrument which has drifted 5 percent from calibration. Continue steps (1) through (4) until (+) and (-) values are determined for both display controls (brightness and contrast).

D. Data collection using the four step method described in C.

Trial 1: (1) Calibrate
(2) Light bar = 150 candela/meter^2
(3) Adjust "light bar" upward 5% to 158 candela/meter^2 using brightness control.
(4) Required adjustment = BRIGHTNESS (-3)

Trial 2: (1) Calibrate
(2) Light bar = 150 candela/meter^2
(3) Adjust "light bar" upward 5% to 158 candela/meter^2 using contrast control.
(4) Required adjustment = CONTRAST (-10)

Trial 3: (1) Calibrate
(2) Light bar = 150 candela/meter^2
(3) Adjust "light bar" downward 5% to 142 candela/meter^2 using brightness control.
(4) Required adjustment = CONTRAST (+8)

Trial 4: (1) Calibrate
(2) Light bar = 150 candela/meter^2
(3) Adjust "light bar" downward 5% to 142 candela/meter^2 using brightness control.
(4) Required adjustment = BRIGHTNESS (+7)

NOTE: Although luminance adjustment for Trial 3 (3) was identical to that of Trial 4 (3) above, required adjustments in part 4 of each trial were different. As mentioned earlier in this appendix (section A) the CS-2000 is internally programmed to indicate which display control, brightness or contrast, is further from proper adjustment. Despite adjustment of only one control,however, both measures are affected. The operator was unable to predictably control this characteristic. It appears to be inherent to the internal programming of this instrument.

E. Error analysis based on interval variation within the $\pm 5\%$ limit reveals a range of:

BRIGHTNESS +7 ⟵⟶ - 3

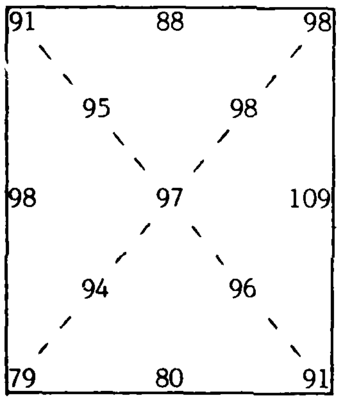
CONTRAST +8 ⟵⟶ -10

APPENDIX C

PHOTOMETRIC MEASUREMENT OF MONITOR DISPLAY (AVERAGE LUMINANCE)

I. Photometric measurement of monitor display (average luminance).

A. A Tektronix J-16 Photometer with J6523 luminance probe was used to measure the luminance of the monitor display. As described in the Nicolet CS-2000 Contrast Sensitivity Testing System Operation Manual, the "standard method" of calibration was used to set the display monitor for 100 candela per square meter average luminance, and 0.50 peak contrast (both measured at screen center).[30] All readings were taken under the same lighting conditions as used for testing. Thirteen measurements were taken as demonstrated below. A 2.3 centimeter spot was used at a distance of 1.5 meters from the screen (measuring circle of approximately 1 deg). All readings were adjusted using the "Correcting Factor" determined by photometric calibration in Part II (below).



Units of measurement = nits (candela/meter^2)

Central luminance = 97 nits

Average luminance = 93 nits

B. % deviation at high extreme (109 nits) =

$$\frac{109 \text{ nits} - 93 \text{ nits}}{93 \text{ nits}} \times 100 = 17.2\%$$

% deviation at low extreme (79 nits) =

$$\frac{79 \text{ nits} - 93 \text{ nits}}{93 \text{ nits}} \times 100 = 15.1\%$$

II. Calibration of photometer using a 342 nit (candela/meter^2) standard (Photo Research Corp., BSR-100-B).

$$\text{Correcting Factor (CF)} = \frac{\text{342 nits (expected)}}{\text{324 nits (actual)}} = 1.056^*$$

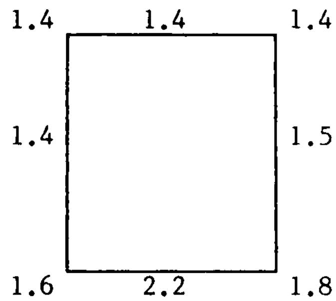
* This factor varies somewhat from one day to the next, probably due to inherent instabilities in the photometer. Due to the characteristics of the reference source (Photo Research Corp., BSR-100-B) short term variations are much less likely here.

APPENDIX D

PHOTOMETRIC MEASUREMENT OF PERIPHERAL SURROUND

I. Measurement of peripheral surround.

A. A Tektronix J-16 Photometer with J6523 luminance probe was used to measure the luminance of the peripheral surround. Eight measurements were taken 2 centimeters from the screen border using a 1 deg measuring circle. All readings were taken under the same lighting conditions as testing. All readings were adjusted using the "Correcting Factor" determined by photometer calibration in Part II (below).



Average luminance = 1.59 nits (candela/meter^2)

B. % Deviation at high extreme (2.2 nits) =

$$\frac{2.2 \text{ nits} - 1.59 \text{ nits}}{1.59 \text{ nits}} \times 100 = 38.4\%$$

% Deviation at low extreme (1.4 nits) =

$$\frac{1.4 \text{ nits} - 1.59 \text{ nits}}{1.59 \text{ nits}} \times 100 = 11.9\%$$

C. Maximum deviation from mean luminance = 38.4%

NOTE: Luminance elevation at lower border of surround is due to reflection from table surface upon which the surround and display monitor rest (Figure 2).

II. Calibration of photometer using a 342 nit (candela/meter^2) standard (Photo Research Corp., BSR-100-B).

A. Photometer reading at start of procedure = 315 nits
Photometer reading at finish of procedure = 320 nits
Average = 318 nits

B. Correcting Factor (CF) = $\frac{\text{342 nits (expected)}}{\text{318 nits (actual)}}$ = 1.075*

C. % Error (start) = $\frac{\text{342 nits} - \text{315 nits}}{\text{342 nits}}$ X 100 = 7.9%

% Error (finish) = $\frac{\text{342 nits} - \text{320 nits}}{\text{342 nits}}$ X 100 = 6.4%

D. Average error over time = 7.15%

* This factor varies somewhat from one day to the next, probably due to inherent instabilities in the photometer. Due to the characteristics of the reference source (Photo Research Corp., BSR-100-B) short term variations are much less likely here.

APPENDIX E

CS-2000 PROGRAM FORMAT

CS-2000 Program Format:

Effects of Soft Contact Lenses on Contrast Sensitivity

MESSAGE	RESPONSE
Standard Set-Up	Default
Standard Method	N
Method (BVAI)	I
# Repeats	4
Preview	Default
Preview Time	2.0
Preview Contrast	0.2
Full Scale Time	Default
Print All Data	Default
Standard Stimuli	N
# Stimuli	8
S. Type (SMCFI)	S
Grating/Bar/User	G
Specify Contrasts	Y

(1) 6.0/.001 — Trial
(2) 1.0/.001 — Trial
(3) 3.0/.001 — Test
(4) 0.5/.001 — Test
(5) 1.0/.001 — Test
(6) 22.8/.001 — Test
(7) 6.0/.001 — Test
(8) 11.4/.001 — Test

APPENDIX F

INSTRUMENT RELIABILITY TESTING (TEST-RETEST)

I. Instrument Reliability Testing (Test-Retest)

A. Test reliability (stability) for the CS-2000 was determined by test administration to randomly chosen subjects on two different occasions. Reliability was defined as the Pearson Product Moment Correlation between the two sets of scores. Program format for test administration was identical to that to be used in the primary study (discussed in detail under the heading "MATERIALS AND METHODS"). Nine randomly chosen subjects (18 eyes) were chosen for this study. Repeat testing did not occur sooner than two days or longer than five days following the initial test.

B. Data (Individual data sheets are numbered (46B - 46J)

C. Program used to calculate the Pearson Correlation Coefficient (pages numbered 46K - 46M)

D. Results

Spatial Frequency	Pearson Product Moment Correlation Coefficient*
0.5	0.77715
1.0	0.842174
3.0	0.949378
6.0	0.947023
11.4	0.948346
22.8	0.888501

* All "r" values are statistically significant at the 0.001 level.

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	33.9	35.9
	T	- 1.53	- 1.555
	SD	.074	.65
1.0	CS	60.6	81.3
	T	- 1.782	- 1.91
	SD	.128	.121
3.0	CS	179.9	203
	T	- 2.255	- 2.307
	SD	.179	.063
6.0	CS	153.1	154.9
	T	- 2.185	- 2.19
	SD	.035	.042
11.4	CS	106.5	127.4
	T	- 2.028	- 2.105
	SD	.036	.092
22.8	CS	46	43.2
	T	- 1.662	- 1.635
	SD	.123	.09

LEFT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	41.7	39.6
	T	- 1.62	- 1.598
	SD	.146	.104
1.0	CS	57.5	68.4
	T	- 1.76	- 1.835
	SD	.039	.068
3.0	CS	154.9	137.2
	T	- 2.19	- 2.137
	SD	.171	.136
6.0	CS	186.2	166.9
	T	- 2.27	- 2.223
	SD	.117	.06
11.4	CS	100.6	88.1
	T	- 2.002	- 1.945
	SD	.023	.153
22.8	CS	46.8	36.9
	T	- 1.67	- 1.567
	SD	.127	.018

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	11.5	14.6
	T	−1.062	− 1.165
	SD	.025	.132
1.0	CS	40.3	43.2
	T	− 1.605	− 1.635
	SD	.05	.073
3.0	CS	100.6	91.2
	T	− 2.002	− 1.96
	SD	.081	.093
6.0	CS	91.2	109
	T	− 1.96	− 2.037
	SD	.099	.082
11.4	CS	71.6	93.3
	T	− 1.855	− 1.97
	SD	.103	.055
22.8	CS	27.2	14
	T	− 1.435	− 1.148
	SD	.063	.054

LEFT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	14.5	11.5
	T	− 1.16	− 1.063
	SD	.076	.035
1.0	CS	51.9	43.9
	T	− 1.715	− 1.642
	SD	.091	.093
3.0	CS	110.9	110.3
	T	− 2.045	− 2.042
	SD	.051	.075
6.0	CS	102.3	129.6
	T	− 2.01	− 2.112
	SD	.074	.075
11.4	CS	61	63.1
	T	− 1.785	− 1.8
	SD	.039	.036
22.8	CS	21.3	14
	T	− 1.327	− 1.145
	SD	.131	.034

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	9.4	8.5
	T	- .975	- .928
	SD	.04	.038
1.0	CS	31.6	19.2
	T	- 1.5	- 1.283
	SD	.092	.029
3.0	CS	67.6	62
	T	- 1.83	- 1.792
	SD	.034	.033
6.0	CS	35.4	41.4
	T	- 1.555	- 1.617
	SD	.062	.147
11.4	CS	29.3	27.1
	T	- 1.467	- 1.432
	SD	.054	.038
22.8	CS	7.6	9.4
	T	- .88	- .975
	SD	.043	.068

LEFT EYE

.5	CS	9.2	6.5
	T	- .962	- .815
	SD	.039	.041
1.0	CS	23.7	24.4
	T	- 1.375	- 1.387
	SD	.032	.031
3.0	CS	51.0	66.8
	T	- 1.707	- 1.825
	SD	.072	.011
6.0	CS	53.4	51.9
	T	- 1.727	- 1.715
	SD	.035	.065
11.4	CS	35.7	33.3
	T	- 1.552	- 1.523
	SD	.095	.04
22.8	CS	15.1	13
	T	- 1.18	- 1.112
	SD	.048	.054

CS=Contrast Sensitivity Name 4
T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	13.3	20
	T	-1.125	-1.3
	SD	.062	.062
1.0	CS	38.7	64.6
	T	-1.588	-1.81
	SD	.062	.109
3.0	CS	171.8	179.9
	T	-2.235	-2.255
	SD	.029	.038
6.0	CS	129.6	130.3
	T	-2.112	-2.115
	SD	.018	.074
11.4	CS	37.6	33.1
	T	-1.575	-1.52
	SD	.0781	.042
22.8	CS	15.6	20.8
	T	-1.192	-1.317
	SD	.115	.077

LEFT EYE

.5	CS	18.2	21.4
	T	-1.26	-1.33
	SD	.052	.062
1.0	CS	51.9	69.6
	T	-1.715	-1.842
	SD	.074	.124
3.0	CS	188.4	192.8
	T	-2.275	-2.285
	SD	.057	.062
6.0	CS	152.2	165
	T	-2.183	-2.217
	SD	.074	.04
11.4	CS	90.7	83.2
	T	-1.957	-1.92
	SD	.061	.102
22.8	CS	32.9	32
	T	-1.517	-1.505
	SD	.134	.128

CS=Contrast Sensitivity Name ____________

T=Contrast Threshold 5

SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	13.3	17.1
	T	- 1.122	- 1.232
	SD	.179	.135
1.0	CS	40	40.5
	T	- 1.602	- 1.607
	SD	.05	.081
3.0	CS	87.6	87.6
	T	- 1.943	- 1.943
	SD	.041	.068
6.0	CS	38.2	41.9
	T	- 1.582	- 1.622
	SD	.229	.083
11.4	CS	17	21.4
	T	- 1.23	- 1.33
	SD	.134	.091
22.8	CS	13.5	10.4
	T	- 1.13	- 1.017
	SD	.088	.108

LEFT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	15.9	15.2
	T	- 1.202	- 1.183
	SD	.115	.092
1.0	CS	42.7	44.7
	T	- 1.63	- 1.65
	SD	.062	.07
3.0	CS	72.4	76.3
	T	- 1.86	- 1.882
	SD	.051	.11
6.0	CS	38	46.5
	T	- 1.58	- 1.667
	SD	.032	.049
11.4	CS	33.3	13.6
	T	- 1.523	- 1.132
	SD	.021	.0781
22.8	CS	14.3	11.1
	T	- 1.155	- 1.045
	SD	.051	.13

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	19.4	7.6
	T	- 1.287	- .882
	SD	.128	.065
1.0	CS	32.5	20.7
	T	- 1.512	- 1.315
	SD	.119	.121
3.0	CS	86.1	57.2
	T	- 1.935	- 1.758
	SD	.062	.059
6.0	CS	61	65.7
	T	- 1.785	- 1.817
	SD	.079	.083
11.4	CS	27.5	23.3
	T	- 1.44	- 1.367
	SD	.083	.073
22.8	CS	11.7	6.6
	T	- 1.067	- .817
	SD	.088	.105

LEFT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	21.6	10.9
	T	- 1.335	- 1.038
	SD	.134	.044
1.0	CS	30.2	26.3
	T	- 1.48	- 1.42
	SD	.027	.043
3.0	CS	79.9	63.8
	T	- 1.902	- 1.805
	SD	.031	.168
6.0	CS	42.2	46.5
	T	- 1.625	- 1.668
	SD	.154	.054
11.4	CS	18	21.1
	T	- 1.255	- 1.325
	SD	.05	.046
22.8	CS	3.5	13.7
	T	- .55	- 1.137
	SD	.215	.139

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	11.5	13.7
	T	- 1.06	- 1.137
	SD	.118	.098
1.0	CS	41.9	38.5
	T	- 1.622	- 1.585
	SD	.033	.043
3.0	CS	24.4	30.7
	T	- 1.388	- 1.487
	SD	.069	.082
6.0	CS	27.5	32.4
	T	- 1.44	- 1.51
	SD	.037	.09
11.4	CS	13.6	15.9
	T	- 1.132	- 1.202
	SD	.127	.111
22.8	CS	6.4	13.4
	T	- .807	- 1.127
	SD	.074	.113

LEFT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	13.6	9.3
	T	- 1.132	- .967
	SD	.071	.052
1.0	CS	27.1	29.2
	T	- 1.433	- 1.465
	SD	.112	.029
3.0	CS	20.9	30.7
	T	- 1.32	- 1.487
	SD	.11	.093
6.0	CS	17.7	13.7
	T	- 1.248	- 1.137
	SD	.173	.114
11.4	CS	10.7	13.7
	T	- 1.027	- 1.138
	SD	.061	.037
22.8	CS	2.9	3.6
	T	- .46	- .555
	SD	.154	.181

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	17	16.1
	T	- 1.23	- 1.207
	SD	.119	.066
1.0	CS	42.2	58.2
	T	- 1.625	- 1.765
	SD	.046	.036
3.0	CS	108.4	105.9
	T	- 2.035	- 2.025
	SD	.056	.105
6.0	CS	66.8	83.7
	T	- 1.825	- 1.923
	SD	.072	.0781
11.4	CS	42.9	51
	T	- 1.632	- 1.707
	SD	.036	.066
22.8	CS	14	19.7
	T	- 1.145	- 1.295
	SD	.132	.262

LEFT EYE

.5	CS	25.4	13.2
	T	- 1.405	- 1.12
	SD	.135	.093
1.0	CS	47.9	44
	T	- 1.68	- 1.64
	SD	.107	.103
3.0	CS	80.4	101.2
	T	- 1.905	- 2.005
	SD	.126	.117
6.0	CS	71.2	61
	T	- 1.852	- 1.785
	SD	.069	.034
11.4	CS	29.9	26.3
	T	- 1.475	- 1.42
	SD	.198	.087
22.8	CS	12.8	15.7
	T	- 1.107	- 1.195
	SD	.063	.158

T=Contrast Threshold
SD=Standard Deviation

9

RIGHT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	16.7	25.4
	T	-1.223	-1.405
	SD	.073	.103
1.0	CS	58.2	88.6
	T	-1.765	-1.947
	SD	.075	.087
3.0	CS	147.9	112.2
	T	-2.17	-2.05
	SD	.057	.059
6.0	CS	123.7	95.5
	T	-2.093	-1.98
	SD	.091	.064
11.4	CS	47.6	50.7
	T	-1.677	-1.705
	SD	.03	.105
22.8	CS	25.6	22
	T	-1.407	-1.342
	SD	.038	.074

LEFT EYE

Spatial Frequency		Trial #1	Trial #2
.5	CS	18.1	18
	T	-1.257	-1.255
	SD	.068	.069
1.0	CS	50.4	43.2
	T	-1.702	-1.635
	SD	.122	.067
3.0	CS	141.3	125.2
	T	-2.15	-2.097
	SD	.04	.156
6.0	CS	141.3	100.6
	T	-2.15	-2.002
	SD	.066	.071
11.4	CS	59.6	46.5
	T	-1.775	-1.667
	SD	.045	.064
22.8	CS	16.9	14.5
	T	-1.228	-1.162
	SD	.132	.054

```
10 REM *** PROGRAM  CALLED  D4:OSTAT09  ***
30 REM ALLOWS FOR ERROR CORRECTIONS AND RESTART  OF THE PROGRAM
40 DIM X[255],Y[255]
50 PRINT "PROGRAM TO CALCULATE CORRELATION COEFFICIENT AND A T-TEST"
60 PRINT "OF SIGNIFICANCE OF MEANS"
70 PRINT "STOP INPUT OF DATA BY TYPING 1001 AS A VALUE"
80 DIM T$[10],U$[10]
90 LET J1=0,K1=0,K2=0,M=0,N=0,L=0,J2=0
100 LET L1=0,L2=0,T1=0,T2=0
110 PRINT "TYPE LABEL OF FIRST SET OF DATA";
120 INPUT T$
130 PRINT "ENTER A DATUM AFTER EACH ?"
140 FOR I=0 TO 255
150   LET L=L+1
160   INPUT X[I];
170   IF X[I]=1001 GOTO 270
180   LET N=N+1
190   REM N IS THE NUMBER OF DATA IN THE SET
200   REM L IS THE NUMBER OF DATA  PER LINE  ON THE TERMINAL
210   IF L<>5 GOTO 240
220   LET L=0
230   PRINT
240 NEXT I
250 PRINT "TOO MANY VALUES"
260 STOP
270 PRINT "<13>ENTER 1 FOR CHANGE,  2 FOR NO  CHANGE";
280 INPUT C1
290 REM C1 IS THE SIGNAL FOR CHANGE OR NO CHANGE
300 IF C1=2 GOTO 460
310 FOR I1=1 TO N
320   PRINT "WHICH ENTRY   DO YOU WISH TO CHANGE?"
330   PRINT "FOR EXAMPLE: 4TH ENTRY TYPE 4"
340   INPUT I2
350   IF I2=999 GOTO 460
360   PRINT "OLD VALUE IS  ";T$;"(";I2;")=";X[I2-1]
370   PRINT "<13>ENTER NEW VALUE"
380   REM I2 INDICATES  WHICH DATA IN THE SET TO BE CHANGED
390   INPUT X2
400   REM X2  IS NEW VALUE
410   PRINT "<13>REPEAT  AS NECESSARY;  TYPE 999 TO END CHANGE"
420   LET X[I2-1]=X2
430   REM ASSIGN  NEW VALUE TO THE (I2-1)TH # IN THE ARRAY
440   REM SINCE THE FIRST # STARTS IN  THE 0TH   POSITION
450 NEXT I1
460 PRINT " HERE IS THE SET OF DATA  YOU JUST ENTERED"
470 FOR I1=1 TO N
480   PRINT T$;"(";I1;")=";X[I1-1]
490 NEXT I1
500 PRINT "<13>TYPE LABEL OF SECOND SET OF DATA";
510 INPUT U$
```

```
520 PRINT "ENTER A DATUM AFTER EACH ?"
530 LET L=0
540 FOR I=0 TO N-1
550   LET L=L+1
560   INPUT Y[I];
570   IF Y[I]=1001 GOTO 640
580   IF L<>5 GOTO 610
590   LET L=0
600   PRINT
610 NEXT I
620 INPUT C
630 IF C=1001 GOTO 670
640 PRINT
650 PRINT "X'S DO NOT EQUAL Y'S"
660 STOP
670 PRINT "<13>ENTER 1 FOR CHANGE 2  FOR NO CHANGE";
680 INPUT C1
690 IF C1=2 GOTO 820
700 FOR I1=1 TO N
710   PRINT "WHICH ENTRY DO YOU WISH TO  CHANGE?"
720   PRINT "FOR EXAMPLE: 4TH ENTRY  TYPE  4"
730   INPUT I2
740   IF I2=999 GOTO 820
750   PRINT "OLD VALUE IS  ";U$;"(";I2;")=";Y[I2-1]
760   PRINT "<13>ENTER NEW VALUE"
770   INPUT Y2
780   REM  Y2 IS  NEW VALUE
790   PRINT "REPEAT AS NECESSARY, ENTER 999 TO END CHANGE"
800   LET Y[I2-1]=Y2
810 NEXT I1
820 PRINT "<13>HERE IS THE SET OF DATA YOU JUST ENTERED"
830 FOR I1=1 TO N
840   PRINT U$;"(";I1;")="Y[I1-1]
850 NEXT I1
860 FOR I=0 TO N-1
870   LET J1=J1+X[I]
880   LET K1=K1+X[I]^2
890   LET J2=J2+Y[I]
900   LET K2=K2+Y[I]^2
910 NEXT I
920 LET L1=J1^2/N
930 LET L2=J2^2/N
940 LET V1=(K1-L1)/(N-1)
950 LET V2=(K2-L2)/(N-1)
960 LET S1=SQR(V1)
970 LET S2=SQR(V2)
980 LET M1=J1/N
990 LET M2=J2/N
1000 FOR I=0 TO N-1
1010   LET T1=T1+(X[I]-M1)^2,T2=T2+(Y[I]-M2)^2
1020   LET M=M+(X[I]-M1)*(Y[I]-M2)
```

```
1030 NEXT I
1040 LET C=M/SQR(T1*T2)
1050 PRINT
1060 PRINT "NUMBER OF VALUES = ";N
1070 PRINT
1080 PRINT ,"MEAN","ST. DEV.","VAR.","SUM OF SQ."
1090 PRINT T$,M1,S1,V1,K1-L1
1100 PRINT U$,M2,S2,V2,K2-L2
1110 PRINT
1120 PRINT "CORRELATION COEFFICIENT = ";C
1130 LET J=0,K=0
1140 FOR I=0 TO N-1
1150   LET Z=X[I]-Y[I]
1160   LET J=J+Z
1170   LET K=K+Z*Z
1180 NEXT I
1190 LET L=J*J/N,V=(K-L)/(N-1),S=SQR(V)
1200 LET M=J/N
1210 LET T=M/(S/SQR(N))
1220 PRINT "<13>RESULTS FOR DIFFERENCES<13>MEAN=";M;"  STD DEV=";S;
1230 PRINT "  VAR=";V;"  SS=";K-L;"<13>T =";T
1240 PRINT "<13>ENTER 1 FOR CONTINUE   2 FOR END"
1250 INPUT C2
1260 REM C2 IS THE SIGNAL FOR CONTINUE OR END
1270 IF C2=1 GOTO 90
1280 END
```

APPENDIX G

SANVAR PROGRAM

```
10 PRINT "SINGLE FACTOR ANALYSIS OF VARIANCE FOR REPEATED MEASURES"
20 PRINT " (ONE-WAY)"
30 PRINT
40 REM SIZING THE MATRIX AND DATA INPUT
50 PRINT "ENTER THE NUMBER OF TREATMENTS";
60 INPUT K
70 PRINT "HOW MANY ELEMENTS ARE THERE PER TREATMENT";
80 INPUT N
90 PRINT "ENTER THE DATA ONE NUMBER AT A TIME, STARTING WITH THE DATA";
100 PRINT " IN ROW ONE,"
110 PRINT "THEN GOING ON TO THE DATA IN ROW TWO, AND SO ON."
120 PRINT
130 PRINT
140 DIM X[N,K],Y[N,K],U[N],S[K]
141 INPUT "WOULD YOU LIKE THE FAST OR PROMPTED FORMAT? 1=FAST, 2=PROMPTED",Z9
142 IF Z9=1 GOTO 202
150 FOR N1=1 TO N
155   PRINT "ENTER SUBJECT ";N1;"FIRST VALUE, SECOND VALUE, ..."
156   PRINT
160   FOR K1=1 TO K
170     PRINT "DATA ";
180     INPUT X[N1,K1]
190   NEXT K1
200 NEXT N1
201 GOTO 220
202 PRINT
203 PRINT "      **********( MAY YOUR DATA BE SIGNIFICANT)**********"
204 FOR N1=1 TO N
205   FOR K1=1 TO K
206     PRINT "DATA ";
207     INPUT X[N1,K1]
208   NEXT K1
209 NEXT N1
210 PRINT
220 PRINT TAB(15);"DATA"
230 MAT  PRINT X
240 PRINT
250 PRINT "TO MAKE CORRECTIONS, ENTER ROW NO., OTHERWISE TYPE -0-";
260 INPUT L1
270 IF L1=0 GOTO 450
280 PRINT "ENTER COLUMN NO.";
290 INPUT W1
300 LET N1=L1
310 LET K1=W1
320 PRINT "DATA";
330 INPUT X[L1,W1]
340 PRINT "ANY MORE CORRECTIONS ? (TYPE 1 FOR YES, 0 FOR NO)";
350 INPUT I
360 IF I=0 GOTO 380
370 GOTO 420
```

```
380 PRINT
390 PRINT TAB(10);"CORRECTED DATA"
400 MAT  PRINT X
410 GOTO 450
420 PRINT "ROW NO.";
430 INPUT L1
440 GOTO 270
450 REM TAKING THE SQUARE OF EACH OF THE DATA
460 FOR N1=1 TO N
470   FOR K1=1 TO K
480     LET Y[N1,K1]=X[N1,K1]^2
490   NEXT K1
500 NEXT N1
510 LET G=0
520 REM G= THE GRAND TOTAL
530 LET R=0
540 REM  R= THE SUM OF P SQUARED
550 FOR N1=1 TO N
560   FOR K1=1 TO K
570     LET P1=P1+X[N1,K1]
580     REM P1=P= THE SUM  OF THE DATA IN THE ROW
590   NEXT K1
600   LET G=G+P1
610   FOR U1=1 TO N
620     REM U= THE SQUARE OF P
630     LET U=P1^2
640   NEXT U1
650   LET R=R+U
660   LET P1=0
670 NEXT N1
680 LET H=0
690 REM H= THE GRAND TOTAL
700 LET Q=0
710 REM Q= THE SUM OF T SQUARED
720 FOR K1=1 TO K
730   FOR N1=1 TO N
740     LET T1=T1+X[N1,K1]
750     REM T=T1=THE SUM OF THE DATA IN THE COLUMN
760   NEXT N1
770   LET H=H+T1
780   FOR S1=1 TO K
790     LET S=T1^2
800     REM S=THE SQUARE OF T
810   NEXT S1
820   LET Q=Q+S
830   LET T1=0
840 NEXT K1
850 LET J1=0
860 REM J1=THE SUM OF THE SQUARES OF EACH OF THE DATA
870 FOR K1=1 TO K
880   FOR N1=1 TO N
```

```
890     LET J1=J1+Y[N1,K1]
900   NEXT N1
910 NEXT K1
920 PRINT
930 REM THE MEAT OF THE SUBJECT (BELOW)
940 LET A=G^2/(K*N)
950 LET B=J1
960 LET C=Q/N
970 LET D=R/K
980 LET V1=D-A
990 LET V2=B-D
1000 LET V3=C-A
1010 LET V4=B-C-D+A
1020 LET V5=B-A
1030 LET E1=N-1
1040 LET E2=N*(K-1)
1050 LET E3=K-1
1060 LET E4=(N-1)*(K-1)
1070 LET E5=(K*N)-1
1080 LET M1=V3/E3
1090 LET M2=V4/E4
1100 IF M2=0 GOTO 1120
1110 LET F=M1/M2
1120 PRINT
1130 PRINT TAB(18);"SOURCES OF     DEGREES OF    MEAN            F"
1140 PRINT TAB(18);"VARIATION      FREEDOM       SQUARE        VALUE"
1150 PRINT
1160 PRINT "BETWEEN TREATMENTS";V1;TAB(40);E1
1170 PRINT "WITHIN TREATMENTS ";V2;TAB(40);E2
1180 IF M2<>0 GOTO 1210
1190 PRINT "TREATMENT          ";V3;TAB(32);E3;TAB(46);M1;TAB(60);"F UNDEF."
1200 GOTO 1220
1210 PRINT "TREATMENT          ";V3;TAB(32);E3;TAB(46);M1;TAB(60);F
1220 PRINT "RESIDUAL           ";V4;TAB(32);E4;TAB(46);M2
1230 PRINT "          TOTAL  ";V5;TAB(40);E5
1240 REM  PREPARED BY ALAN RHODES, 1978
1250 END
```

APPENDIX H

"t" TEST (RELATED MEASURES) PROGRAM

```
10 PRINT "PROGRAM TO CALCULATE SUMS AND PRODUCTS OF THE DIFFERENCE IN"
20 PRINT "PAIRED DATA POINTS AND STUDENT'S-T VALUE<13>"
30 PRINT "TYPE 1001 FOR X TO STOP THE INPUT OF VALUES"
40 LET N=0,L=0,J=0,K=0
50 FOR I=0 TO 255
60   LET L=L+1
70   PRINT " X=";
80   INPUT Z;
90   IF Z=1001 GOTO 200
100   PRINT " Y=";
110   INPUT Y;
120   LET X=Z-Y
130   LET N=N+1
140   IF L<>3 GOTO 170
150   LET L=0
160   PRINT
170   LET J=J+X
180   LET K=K+X*X
190 NEXT I
200 LET L=J*J/N
210 LET V=(K-L)/(N-1)
220 LET S=SQR(V)
230 LET M=J/N
240 PRINT "<13>N=";N;" M=";M;" S=";S;" V=";V;" SS=";(K-L)
250 LET T=M/(S/SQR(N))
260 PRINT "T-VALUE=";T
270 END
```

APPENDIX I

DATA COLLECTION SHEETS (DESCRIPTIVE)

Name ________________ # 49A

Age 15 ①

BASELINE

		Distance Acuity
Spectacle Rx:	OD -2.50-0.50 x 090	20/15
	OS -2.50 -0.25 x 085	20/15
Pupil Diameter:	OD 5.0 mm	
	OS 5.0 mm	

DISPENSING

Contact Lens Rx:	OD -2.75 CSI	
	OS -2.75 CSI	Distance Acuity (thru over refraction)
Over Refraction:	OD plano	20/15^-1
	OS plano	20/15^-1
Wearing Time:	1 hour	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE WEEK

Distance Acuity (thru over refraction):		OD 20/15^-3
		OS 20/15^-2
Wearing Time:	4 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE MONTH

Distance Acuity (thru over refraction):		OD 20/15^-2
		OS 20/15^-2
Wearing Time:	4 1/2 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

Name ______________ # 49B

Age 32

BASELINE

Spectacle Rx: OD +3.00 -0.50 x 090 — Distance Acuity 20/15^{-1}

OS +2.50 -0.25 x 090 — 20/20^{+3}

Pupil Diameter: OD 4.5 mm

OS 4.5 mm

DISPENSING

Contact Lens Rx: OD +4.00 CSI

OS +3.25 CSI

Distance Acuity (thru over refraction)

Over Refraction: OD -0.50 sph — 20/15^{-1}

OS -0.50 sph — 20/20^{+}

Wearing Time: 1 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15^{-1}

OS 4.5 mm — 20/15^{-3}

ONE WEEK

Distance Acuity (thru over refraction): OD 20/20^{-1}

OS 20/20

Wearing Time: 4 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15^{-1}

OS 5.0 mm — 20/20^{+1}

Pt. notes vision seems better with glasses

ONE MONTH

Distance Acuity (thru over refraction): OD 20/20^{+1}

OS 20/20

Wearing Time: 6 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15^{-2}

OS 4.5 mm — 20/20^{+1}

Age 23 (3) 49C

BASELINE

Spectacle Rx: OD −1.50 −0.50 x 160 — Distance Acuity 20/15
OS −1.25 −0.50 x 096 — 20/15

Pupil Diameter: OD 4.5 mm
OS 4.5 mm

DISPENSING

Contact Lens Rx: OD −1.25 Durasoft II - UltraT
OS −1.25

Over Refraction: OD pl −0.50 x 135 — Distance Acuity (thru over refraction) 20/15⁻²
OS pl −0.50 x 030 — 20/15⁻²

Wearing Time: 1 hour — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15
OS 4.5 mm — 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15⁻¹
OS 20/15⁻³

Wearing Time: 4 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15
OS 5.0 mm — 20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15⁻¹
OS 20/15⁻²

Wearing Time: 4 1/2 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15
OS 4.5 mm — 20/15

Name ______________ # 49D

Age 25 (4)

BASELINE

		Distance Acuity
Spectacle Rx:	OD -1.50 -0.25 x 048	20/15⁻¹
	OS -1.75 sph	20/15⁻¹
Pupil Diameter:	OD 4.0 mm	
	OS 4.0 mm	

DISPENSING

Contact Lens Rx:	OD -1.75 CSI	
	OS -1.75	Distance Acuity (thru over refraction)
Over Refraction:	OD -0.25	20/20+2
	OS -0.25	20/20+2
Wearing Time:	1 hour	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 4.5 mm	20/15-
	OS 4.5 mm	20/15-

ONE WEEK

Distance Acuity (thru over refraction):	OD	20/20+2
	OS	20/20+2
Wearing Time: 3 hours		Spectacle Acuity (post CL wear)
Pupil Diameter: OD 4.5 mm		20/15-
OS 4.5 mm		20/15-

ONE MONTH

Distance Acuity (thru over refraction):	OD	20/20+3
	OS	20/20+3
Wearing Time: 6 1/2 hours		Spectacle Acuity (post CL wear)
Pupil Diameter: OD 4.5 mm		20/15⁻¹
OS 4.5 mm		20/15⁻¹

Name ____________________ # 49E

Age 23 (5)

BASELINE

Spectacle Rx: OD -1.50 sph — Distance Acuity 20/15 -1

OS -1.75 -0.25 x 180 — 20/15

Pupil Diameter: OD 5.0 mm

OS 5.0 mm

DISPENSING

Contact Lens Rx: OD -2.00 Hydron "06"

OS -2.00

Over Refraction: OD plano — Distance Acuity (thru over refraction) 20/15

OS +0.25 sph — 20/15

Wearing Time: 1 hour — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15 -1

OS 4.5 mm — 20/15 -1

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15 -1

OS 20/15

Wearing Time: 4 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 5 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15 -2

Name ______________ (6) # 49F

Age 38

BASELINE

		Distance Acuity
Spectacle Rx:	OD -2.00 sph	20/15⁻¹
	OS -1.25 sph	20/15⁻¹
Pupil Diameter:	OD 5.0 mm	
	OS 5.0 mm	

DISPENSING

Contact Lens Rx:	OD -2.00 CSI	
	OS -1.25	Distance Acuity (thru over refraction)
Over Refraction:	OD plano	20/15
	OS plano	20/15
Wearing Time:	1 hour	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time:	3 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15⁻²

OS 20/15⁻²

Wearing Time:	5 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15⁻¹

Name ____________ # 49G

Age 34 (5)

BASELINE

Spectacle Rx: OD -2.50 -0.50 x 150 — Distance Acuity 20/15

OS -2.50 -0.50 x 030 — 20/15

Pupil Diameter: OD 5.0 mm

OS 5.0 mm

DISPENSING

Contact Lens Rx: OD -2.50 sph Hydrocurve II

OS -2.50 sph

Distance Acuity (thru over refraction)

Over Refraction: OD +0.25 -0.50 x 150 — 20/20+

OS +0.25 -0.50 x 035 — 20/15-

Wearing Time: 1 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15-

OS 20/15-

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/20+3

OS 20/20+

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

Name ______________ # 49H

Age 35 (8)

BASELINE

Spectacle Rx: OD -4.75 sph — Distance Acuity 20/20+2

OS -4.25-0.50 x 002 — 20/20+3

Pupil Diameter: OD 4.5 mm

OS 4.5 mm

DISPENSING

Contact Lens Rx: OD -4.75 Hydrocurve II

OS -4.50

Over Refraction: OD plano — Distance Acuity (thru over refraction) 20/20+2

OS plano — 20/15-2

Wearing Time: 1 hour

Pupil Diameter: OD 4.5 mm — Spectacle Acuity (post CL wear) 20/15-1

OS 4.5 mm — 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15-3

OS 20/15

Wearing Time: 4 hours

Pupil Diameter: OD 4.5 mm — Spectacle Acuity (post CL wear) 20/20+3

OS 4.5 mm — 20/15-2

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15-1

OS 20/15-1

Wearing Time: 8 hours

Pupil Diameter: OD 4.5 mm — Spectacle Acuity (post CL wear) 20/15-2

OS 4.5 mm — 20/15-2

Name ________________ # 491

Age 23 (9)

BASELINE

			Distance Acuity
Spectacle Rx:	OD -2.25 sph		20/15
	OS -2.25 -0.25 x 100		20/15
Pupil Diameter:	OD 5.0 mm		
	OS 5.0 mm		

DISPENSING

Contact Lens Rx:	OD -2.25	Hydrocurve II	
	OS -2.25		Distance Acuity (thru over refraction)
Over Refraction:	OD plano		20/20+
	OS plano		20/15-
Wearing Time:	1 hour		Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm		20/15
	OS 5.0 mm		20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

		Spectacle Acuity (post CL wear)
Wearing Time:	4 hours	
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

		Spectacle Acuity (post CL wear)
Wearing Time:	6 hours	
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

Name______________________ # 49J

Age 24 (10)

BASELINE

		Distance Acuity
Spectacle Rx:	OD -6.50 -0.50 x 035	20/15
	OS -6.50 -0.50 x 075	20/15
Pupil Diameter:	OD 5.0 mm	
	OS 5.0 mm	

DISPENSING

Contact Lens Rx:	OD - 6.00 B+L "U-4"	
	OS - 6.00	Distance Acuity (thru over refraction)
Over Refraction:	OD plano	20/15⁻¹
	OS plano	20/15⁻¹
Wearing Time:	1 hour	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE WEEK

Distance Acuity (thru over refraction):		OD 20/15⁻¹
		OS 20/15⁻²
Wearing Time:	4 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE MONTH

Distance Acuity (thru over refraction):		OD 20/15⁻²
		OS 20/15⁻²
Wearing Time:	8 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/20⁺
	OS 5.0 mm	20/20⁺

Name _________________ # 49K

Age 28 (11)

BASELINE

		Distance Acuity
Spectacle Rx:	OD −1.00−0.75 x 030	20/15⁻¹
	OS −3.00−0.50 X 122	20/15⁻¹
Pupil Diameter:	OD 5.0 mm	
	OS 5.0 mm	

DISPENSING

Contact Lens Rx:	OD −1.25 Hydrocurve	
	OS −3.25	Distance Acuity (thru over refraction)
Over Refraction:	OD pl −0.75 x 030	20/15⁻²
	OS pl −0.50 x 100	20/15⁻¹
Wearing Time:	1/2 hour	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15⁻²
	OS 5.0 mm	20/15⁻¹

ONE WEEK

Distance Acuity (thru over refraction):		OD 20/15⁻¹
		OS 20/15⁻³
Wearing Time:	4 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15⁻²
	OS 5.0 mm	20/15⁻¹

ONE MONTH

Distance Acuity (thru over refraction):		OD 20/15⁻²
		OS 20/15⁻²
Wearing Time:	5 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 5.0 mm	20/15⁻¹
	OS 5.0 mm	20/15⁻¹

Name ________________ # 49L

Age 23 (12)

BASELINE

Spectacle Rx:		Distance Acuity
	OD -2.25 sph	20/15
	OS -1.50 -0.50 x 180	20/15

Pupil Diameter: OD 5.0 mm

OS 5.0 mm

DISPENSING

Contact Lens Rx: OD -2.50 Hydrocurve II

OS -1.75

Over Refraction:		Distance Acuity (thru over refraction)
	OD pl	20/15-1
	OS pl	20/15-1

Wearing Time: 1 hour

Pupil Diameter:		Spectacle Acuity (post CL wear)
	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 4 hours

Pupil Diameter:		Spectacle Acuity (post CL wear)
	OD 5.0 mm	20/15
	OS 5.0 mm	20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 4 hours

Pupil Diameter:		Spectacle Acuity (post CL wear)
	OD 4.5 mm	20/15
	OS 4.5 mm	20/15

Name______________ # 49M

Age 25 (13)

BASELINE

			Distance Acuity
Spectacle Rx:	OD	-2.25 sph	20/15
	OS	-2.25 sph	20/15
Pupil Diameter:	OD	5.5 mm	
	OS	5.5 mm	

DISPENSING

Contact Lens Rx: OD -2.25 Hydrocurve II

OS -2.25

Distance Acuity (thru over refraction)

Over Refraction: OD plano 20/15

OS plano 20/15⁻¹

Wearing Time: 1 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.5 mm 20/15

OS 5.5 mm 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15^{-1}

OS 20/15

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm 20/15

OS 5.0 mm 20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.5 mm 20/15

OS 5.5 mm 20/15

Name ________________ # 49N

Age 27 (14)

BASELINE

Spectacle Rx: OD -2.00 sph | Distance Acuity 20/15

OS -2.25 sph | 20/15

Pupil Diameter: OD 5.0 mm

OS 5.0 mm

DISPENSING

Contact Lens Rx: OD -2.25 Hydrocurve

OS -2.25

Over Refraction: OD plano | Distance Acuity (thru over refraction) 20/15

OS plano | 20/15⁻²

Wearing Time: 1 hour

Pupil Diameter: OD 5.0 mm | Spectacle Acuity (post CL wear) 20/15

OS 5.0 mm | 20/15⁻²

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15

OS 20/15⁻¹

Wearing Time: 4 hours

Pupil Diameter: OD 4.5 mm | Spectacle Acuity (post CL wear) 20/15

OS 4.5 mm | 20/15⁻¹

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/20⁺³

Wearing Time: 4 hours

Pupil Diameter: OD 5.0 mm | Spectacle Acuity (post CL wear) 20/15

OS 5.0 mm | 20/15⁻²

Name ____________ # 490

Age 36 (15)

BASELINE

Spectacle Rx: OD -1.75 sph — Distance Acuity 20/ 15^-2

OS -1.50 sph — 20/ 15^-2

Pupil Diameter: OD 3.5 mm

OS 3.5 mm

DISPENSING

Contact Lens Rx: OD -1.25 Hydrocurve II

OS -1.00

Distance Acuity (thru over refraction)

Over Refraction: OD -0.25 sph — 20/ 15^-2

OS plano — 20/ 15^-2

Wearing Time: 1 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 3.5 mm — 20/ 20^+2

OS 3.5 mm — 20/ 20^+2

ONE WEEK

Distance Acuity (thru over refraction): OD 20/ 15^-2

OS 20/ 15^-1

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.0 mm — 20/ 15^-2

OS 4.0 mm — 20/ 15^-1

ONE MONTH

Distance Acuity (thru over refraction): OD 20/ 15^-1

OS 20/ 15^-2

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.0 mm — 20/ 15^-2

OS 4.0 mm — 20/ 15^-1

Name ______________ # 491

Age 22 (16)

BASELINE

Spectacle Rx: OD +0.50 sph — Distance Acuity 20/15

OS +0.75 -0.25 x 083 — 20/15

Pupil Diameter: OD 5.0 mm

OS 5.0 mm

DISPENSING

Contact Lens Rx: OD +0.50 Hydrocurve II

OS +0.75

Over Refraction: OD -0.25 — Distance Acuity (thru over refraction) 20/15

OS plano — 20/15

Wearing Time: 1 hour — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 4 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15

OS 4.5 mm — 20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 4 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 4.5 mm — 20/15

OS 4.5 mm — 20/15

Name________________ # 49Q

Age 24 (17)

BASELINE

Spectacle Rx: OD -4.25 sph — Distance Acuity 20/15

OS -4.50 sph — 20/15

Pupil Diameter: OD 5.5 mm

OS 5.5 mm

DISPENSING

Contact Lens Rx: OD -4.50 Hydrocurve II

OS -4.25

Over Refraction: OD plano — Distance Acuity (thru over refraction) 20/15

OS -0.25 sph — 20/15

Wearing Time: 1 hour — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.5 mm — 20/15

OS 5.5 mm — 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 4 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15

OS 20/15

Wearing Time: 5 hours — Spectacle Acuity (post CL wear)

Pupil Diameter: OD 5.0 mm — 20/15

OS 5.0 mm — 20/15

Name ____________________ # 49R

Age 26 (18)

BASELINE

		Distance Acuity
Spectacle Rx:	OD -2.25-0.25 x180	20/15
	OS -2.25-0.25 x172	20/15
Pupil Diameter:	OD 4.5 mm	
	OS 4.5 mm	

DISPENSING

Contact Lens Rx:	OD -2.25 Hydrocurve	
	OS -2.25	Distance Acuity (thru over refraction)
Over Refraction:	OD plano	20/20+3
	OS plano	20/15-3
Wearing Time:	1 hour	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 4.5 mm	20/15
	OS 4.5 mm	20/15

ONE WEEK

Distance Acuity (thru over refraction):		OD 20/15-1
		OS 20/15
Wearing Time:	4 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 4.5 mm	20/15
	OS 4.5 mm	20/15

ONE MONTH

Distance Acuity (thru over refraction):		OD 20/15-1
		OS 20/15
Wearing Time:	4 1/2 hours	Spectacle Acuity (post CL wear)
Pupil Diameter:	OD 4.5 mm	20/15
	OS 4.5 mm	20/15

Name (19) # 49S

Age 24

BASELINE

Spectacle Rx: OD -4.50 sph — Distance Acuity 20/15

OS -4.50 sph — 20/15+

Pupil Diameter: OD 7.0 mm

OS 7.0 mm

DISPENSING

Contact Lens Rx: OD -4.50 B+L "U-4"

OS -4.75

Distance Acuity (thru over refraction)

Over Refraction: OD plano — 20/15

OS plano — 20/15

Wearing Time: 1 hour

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 6.5 mm — 20/15

OS 6.5 mm — 20/15

ONE WEEK

Distance Acuity (thru over refraction): OD 20/15-

OS 20/15-1

Wearing Time: 4 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 7.0 mm — 20/15-

OS 7.0 mm — 20/15-

ONE MONTH

Distance Acuity (thru over refraction): OD 20/15-

OS 20/15+

Wearing Time: 4 1/2 hours

Spectacle Acuity (post CL wear)

Pupil Diameter: OD 7.0 mm — 20/15-

OS 7.0 mm — 20/15+

APPENDIX J

DATA COLLECTION SHEETS (TEST RESULTS)

CS=Contrast Sensitivity Name ______________

T=Contrast Threshold

SD=Standard Deviation (1) 50A

RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	27.4	34.5	29.3	33.9	42.7	20.2	28.3
	T	-1.438	-1.537	-1.467	-1.53	-1.63	-1.305	-1.452
	SD	.079	.202	.188	.098	.154	.115	.143
1.0	CS	48.7	73.7	44.9	69.2	70	58.5	61.3
	T	-1.687	-1.867	-1.652	-1.84	-1.845	-1.767	-1.787
	SD	.101	.064	.075	.116	.134	.0891	.167
3.0	CS	160.3	163.1	106.5	161.3	110.9	150.5	130.3
	T	-2.205	-2.212	-2.027	-2.207	-2.045	-2.117	-2.115
	SD	.234	.122	.081	.054	.136	.131	.12
6.0	CS	111.8	105.3	105.9	86.1	125.9	105.3	126.6
	T	-2.047	-2.023	-2.025	-1.935	-2.1	-2.023	-2.102
	SD	.095	.127	.144	.088	.121	.029	.15
11.4	CS	45.2	34.3	41.4	46.8	67.2	40.7	50.4
	T	-1.655	-1.535	-1.617	-1.67	-1.827	-1.61	-1.702
	SD	.09	.114	.091	.085	.063	.129	.23
22.8	CS	34.5	34.9	23.3	18.4	19.8	29.3	36.1
	T	-1.537	-1.543	-1.367	-1.265	-1.297	-1.467	-1.558
	SD	.182	.198	.132	.189	.133	.158	.192

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	22.6	31.3	34.9	28.2	26.2	25	21.8
	T	-1.355	-1.495	-1.542	-1.45	-1.417	-1.398	-1.337
	SD	.14	.131	.175	.092	.195	.188	.088
1.0	CS	49.3	77.2	56.2	59.9	70.4	57.2	76.3
	T	-1.692	-1.887	-1.75	-1.77	-1.847	-1.758	-1.883
	SD	.046	.179	.091	.101	.183	.104	.285
3.0	CS	85.6	128.8	106.5	116.1	126.6	114.2	118.2
	T	-1.932	-2.11	-2.027	-2.065	-2.103	-2.057	-2.072
	SD	.072	.08	.068	.135	.174	.029	.075
6.0	CS	132.6	77.6	79.9	79	106.5	147.1	124.5
	T	-2.122	-1.89	-1.903	-1.898	-2.028	-2.167	-2.095
	SD	.183	.111	.191	.072	.144	.065	.062
11.4	CS	43.7	48.7	45.4	56.6	51.3	57.5	57.2
	T	-1.64	-1.687	-1.657	-1.752	-1.71	-1.76	-1.758
	SD	.082	.155	.173	.15	.095	.076	.187
22.8	CS	40.3	49	20.1	24.3	36.5	27.1	39.8
	T	-1.605	-1.69	-1.302	-1.385	-1.562	-1.432	-1.6
		.058	.134	.205	.091	.25	.202	.133

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	19.2	15.1	12	11	14.5	8.9	11
	T	-1.282	-1.18	-1.077	-1.04	-1.162	-.950	-1.042
	SD	.105	.07	.05	.063	.043	.076	.092
1.0	CS	31.6	38.7	34.1	32.9	32.9	25.3	35.5
	T	-1.5	-1.588	-1.532	-1.517	-1.517	-1.402	-1.55
	SD	.041	.105	.099	.0781	.054	.058	.0971
3.0	CS	82.2	79.4	89.6	62	94.4	82.2	77.6
	T	-1.915	-1.9	-1.952	-1.792	-1.975	-1.915	-1.89
	SD	.023	.021	.0861	.044	.048	.05	.082
6.0	CS	74.6	67.6	75.4	48.1	74.1	59.6	79.9
	T	-1.872	-1.83	-1.878	-1.682	-1.87	-1.775	-1.902
	SD	.095	.061	.033	.068	.06	.055	.048
11.4	CS	46.5	43.9	47.3	38	40.7	26.6	54
	T	-1.667	-1.642	-1.675	-1.58	-1.61	-1.425	-1.733
	SD	.057	.029	.066	.0751	.067	.125	.0891
22.8	CS	25.3	6.8	17.8	16.8	16.5	13.9	16.8
	T	-1.402	-.83	-1.25	-1.225	-1.217	-1.143	-1.225
	SD	.109	.249	.14	.091	.133	.054	.04

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	19.4	17.7	14	13.9	11.4	9.5	10.1
	T	-1.287	-1.247	-1.145	-1.142	-1.057	-.9769	-1.003
	SD	.13	.29	.05	.032	.071	.148	.087
1.0	CS	36.9	32.5	39.6	28.3	29.7	31.6	31.6
	T	-1.568	-1.512	-1.597	-1.452	-1.472	-1.5	-1.5
	SD	.036	.054	.096	.051	.033	.094	.118
3.0	CS	67.6	62	60.6	74.1	56.9	91.2	82.7
	T	-1.83	-1.792	-1.782	-1.87	-1.755	-1.96	-1.917
	SD	.056	.094	.074	.107	.038	.031	.062
6.0	CS	61.7	72.9	61.7	60.6	66.8	86.6	65.3
	T	-1.79	-1.863	-1.79	-1.782	-1.825	-1.938	-1.815
	SD	.067	.016	.079	.111	.085	.04	.075
11.4	CS	38.5	48.7	38.2	40.5	40.7	33.9	41.9
	T	-1.585	-1.687	-1.582	-1.607	-1.61	-1.53	-1.622
	SD	.061	.116	.04	.088	.094	.157	.026
22.8	CS	15	13.9	13	11.9	15.7	6.5	10.8
	T	-1.175	-1.142	-1.112	-1.075	-1.195	-.813	-1.032
	SD	.066	.095	.104	.0861	.092	.062	.042

T=Contrast Threshold
SD=Standard Deviation

(3)

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	36.9	27.2	20.4	21.6	18.9	16.1	21.3
	T	-1.568	-1.435	-1.31	-1.335	-1.277	-1.208	-1.327
	SD	.253	.094	.186	.092	.151	.037	.111
1.0	CS	65.3	61.7	58.9	44.4	61.3	53.1	52.8
	T	-1.815	-1.79	-1.77	-1.647	-1.788	-1.725	-1.722
	SD	.137	.034	.046	.0781	.051	.052	.083
3.0	CS	120.9	143.7	128.1	130.3	134.1	131.1	141.3
	T	-2.082	-2.157	-2.107	-2.115	-2.127	-2.117	-2.15
	SD	.092	.136	.102	.121	.062	.082	.278
6.0	CS	102.3	109.6	131.8	116.1	136.5	142.1	139.6
	T	-2.01	-2.04	-2.12	-2.065	-2.135	-2.152	-2.145
	SD	.068	.125	.025	.044	.042	.079	.067
11.4	CS	37.8	38.9	51.6	35.5	66.5	56.6	102.3
	T	-1.577	-1.59	-1.712	-1.55	-1.822	-1.752	-2.01
	SD	.062	.094	.213	.07	.041	.027	.137
22.8	CS	19.4	14.6	24	7.0	18.2	16.8	21
	T	-1.288	-1.165	-1.38	-.843	-1.26	-1.225	-1.322
	SD	.097	.041	.035	.065	.027	.082	.04

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	22.9	19.2	22.5	21.6	28.2	20.8	26.2
	T	-1.36	-1.282	-1.352	-1.335	-1.45	-1.317	-1.418
	SD	.071	.106	.077	.111	.06	.115	.06
1.0	CS	62.4	58.9	64.6	57.9	51	45.2	56.6
	T	-1.795	-1.77	-1.81	-1.762	-1.707	-1.655	-1.753
	SD	.047	.135	.247	.067	.108	.056	.081
3.0	CS	147.1	129.6	164.1	138	147.9	113.5	135.7
	T	-2.167	-2.112	-2.215	-2.14	-2.17	-2.055	-2.133
	SD	.07	.083	.09	.048	.06	.034	.04
6.0	CS	113.5	153.1	147.9	151.4	147.9	133.4	190.5
	T	-2.055	-2.185	-2.17	-2.18	-2.17	-2.125	-2.28
	SD	.065	.066	.034	.032	.055	.029	.118
11.4	CS	70.4	76.3	95	74.6	88.6	49.5	101.7
	T	-1.847	-1.883	-1.977	-1.872	-1.948	-1.695	-2.007
	SD	.095	.036	.088	.047	.036	.204	.09
22.8	CS	26.6	21.3	16.4	9.9	29.3	12.7	22.8
	T	-1.425	-1.327	-1.215	-.995	-1.467	-1.103	-1.358
	SD	.142	.075	.07	.087	.041	.029	.113

T=Contrast Threshold
SD=Standard Deviation

Name ___ (4) 5OD

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	12.4	17.2	18.8	15	21.9	18.5	19.7
	T	-1.092	-1.235	-1.275	-1.175	-1.34	-1.267	-1.295
	SD	.019	.087	.14	.025	.045	.054	.099
1.0	CS	33.6	44.9	41.7	49	59.2	41.2	43.4
	T	-1.527	-1.653	-1.62	-1.69	-1.772	-1.615	-1.637
	SD	.097	.128	.082	.048	.088	.074	.094
3.0	CS	69.6	83.7	117.5	120.9	121.6	133.4	125.9
	T	-1.843	-1.923	-2.07	-2.082	-2.085	-2.125	-2.1
	SD	.057	.074	.064	.04	.073	.174	.039
6.0	CS	100	120.9	97.7	128.8	166	116.8	105.3
	T	-2.0	-2.082	-1.99	-2.11	-2.22	-2.067	-2.023
	SD	.053	.055	.067	.066	.037	.029	.055
11.4	CS	42.7	58.9	82.2	73.3	82.7	63.1	61
	T	-1.63	-1.77	-1.915	-1.865	-1.917	-1.8	-1.785
	SD	.037	.132	.053	.092	.052	.047	.103
22.8	CS	24.3	11.5	30.5	19.5	45.2	18.4	24.5
	T	-1.386	-1.063	-1.485	-1.29	-1.655	-1.265	-1.39
	SD	.087	.022	.139	.058	.0781	.081	.054

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	13.5	14	15.2	19.7	17	18.9	24.4
	T	-1.13	-1.145	-1.182	-1.295	-1.23	-1.277	-1.388
	SD	.062	.063	.093	.0971	.066	.084	.107
1.0	CS	54	44.9	42.2	41	36.7	51.9	39.4
	T	-1.732	-1.652	-1.625	-1.612	-1.565	-1.715	-1.595
	SD	.126	.119	.058	.037	.0781	.05	.08
3.0	CS	77.2	91.7	109.6	107.2	100	83.7	105.3
	T	-1.887	-1.962	-2.04	-2.03	-2.0	-1.922	-2.022
	SD	.088	.0781	.053	.105	.102	.096	.055
6.0	CS	95	128.1	125.2	82.7	88.1	75.9	100.6
	T	-1.977	-2.107	-2.098	-1.918	-1.945	-1.88	-2.002
	SD	.087	.057	.084	.059	.101	.037	.03
11.4	CS	79.4	71.6	84.1	48.7	57.2	51	65.7
	T	-1.9	-1.855	-1.925	-1.687	-1.757	-1.707	-1.817
	SD	.055	.08	.056	.085	.045	.085	.045
22.8	CS	22.8	21.5	35.9	15.8	19.3	13.2	27.5
	T	-1.358	-1.332	-1.555	-1.197	-1.285	-1.12	-1.44
	SD	.054	.046	.042	.0891	.0861	.147	.101

T=Contrast Threshold
SD=Standard Deviation

(5)

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	17.9	34.9	20.2	24.3	32.4	25.9	34.3
	T	-1.253	-1.542	-1.305	-1.385	-1.51	-1.412	-1.535
	SD	.082	.022	.111	.135	.124	.241	.198
1.0	CS	40.3	55.9	36.7	73.7	70	55.3	64.2
	T	-1.605	-1.748	-1.565	-1.867	-1.845	-1.742	-1.807
	SD	.055	.149	.093	.054	.04	.136	.063
3.0	CS	109.6	105.3	99.4	163.1	147.1	142.9	122.3
	T	-2.04	-2.023	-1.997	-2.212	-2.167	-2.155	-2.087
	SD	.071	.082	.031	.094	.149	.069	.069
6.0	CS	99.4	79.9	70.4	163.1	103.5	159.4	89.1
	T	-1.997	-1.902	-1.847	-2.212	-2.015	-2.202	-1.95
	SD	.081	.05	.069	.069	.061	.054	.037
11.4	CS	71.4	76.7	23.7	122.3	42.7	79	32.2
	T	-1.854	-1.885	-1.375	-2.087	-1.63	-1.897	-1.507
	SD	.083	.029	.067	.129	.075	.085	.134
22.8	CS	16.1	17.3	15.4	10.8	12.6	17.7	15
	T	-1.208	-1.237	-1.188	-1.032	-1.1	-1.248	-1.175
	SD	.083	.077	.107	.068	.154	.108	.076

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	25	20	20.7	27.5	26.2	23	20.9
	T	-1.398	-1.3	-1.315	-1.44	-1.417	-1.362	-1.32
	SD	.081	.13	.177	.06	.128	.108	.064
1.0	CS	58.5	55.9	54.3	86.1	61	61.7	37.4
	T	-1.767	-1.747	-1.735	-1.935	-1.785	-1.79	-1.572
	SD	.0971	.041	.132	.147	.034	.033	.138
3.0	CS	158.5	124.5	112.2	146.2	109.6	138.8	102.9
	T	-2.2	-2.095	-2.05	-2.165	-2.04	-2.143	-2.012
	SD	.016	.126	.107	.099	.116	.1	.148
6.0	CS	156.7	124.5	98.9	102.9	130.3	114.8	98.9
	T	-2.195	-2.095	-1.995	-2.013	-2.115	-2.06	-1.995
	SD	.0861	.0891	.123	.045	.034	.062	.063
11.4	CS	77.2	52.2	54	61.7	70.4	75.9	51.6
	T	-1.887	-1.717	-1.732	-1.79	-1.847	-1.88	-1.713
	SD	.036	.0891	.165	.046	.126	.065	.063
22.8	CS	20.5	9.4	17.7	18	15.8	22.4	16.4
	T	-1.312	-.975	-1.247	-1.255	-1.2	-1.35	-1.215
	SD	.098	.108	.113	.128	.18	.087	.055

SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	25.3	31.6	28.5	33.3	32.2	34.5	38.2
	T	-1.452	-1.5	-1.455	-1.523	-1.507	-1.537	-1.583
	SD	.076	.083	.099	.168	.069	.149	.147
1.0	CS	61	68.8	63.8	54.6	80.4	77.2	72
	T	-1.785	-1.837	-1.805	-1.738	-1.905	-1.887	-1.858
	SD	.145	.038	.045	.054	.095	.09	.142
3.0	CS	132.6	132.6	118.9	148.8	131.8	137.2	149.6
	T	-2.122	-2.112	-2.075	-2.172	-2.12	-2.137	-2.175
	SD	.072	.108	.074	.189	.11	.043	.137
6.0	CS	134.1	158.5	133.4	143.7	93.3	153.1	140.4
	T	-2.127	-2.2	-2.125	-2.157	-1.97	-2.185	-2.148
	SD	.088	.115	.054	.067	.07	.071	.081
11.4	CS	77.2	116.1	78.5	109	59.9	92.3	92.8
	T	-1.887	-2.065	-1.895	-2.037	-1.778	-1.965	-1.968
	SD	.033	.066	.033	.098	.073	.084	.073
22.8	CS	28.5	38.7	28	41.7	33.7	27.4	24.7
	T	-1.455	-1.587	-1.447	-1.62	-1.527	-1.437	-1.393
	SD	.075	.038	.135	.064	.114	.091	.056

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	40	40.3	32.9	23.6	47.3	41.4	41.2
	T	-1.603	-1.605	-1.518	-1.372	-1.675	-1.617	-1.615
	SD	.103	.096	.0981	.033	.0971	.128	.113
1.0	CS	79	68	75.4	89.6	104.1	81.8	101.2
	T	-1.898	-1.832	-1.877	-1.952	-2.018	-1.913	-2.005
	SD	.098	.072	.039	.073	.141	.023	.09
3.0	CS	123.7	145.4	116.8	147.9	173.8	139.6	123
	T	-2.092	-2.162	-2.067	-2.17	-2.24	-2.145	-2.09
	SD	.09	.04	.125	.092	.066	.13	.083
6.0	CS	139.6	160.3	131.1	146.2	151.4	138	146.2
	T	-2.145	-2.205	-2.117	-2.165	-2.18	-2.14	-2.165
	SD	.047	.017	.104	.069	.076	.062	.182
11.4	CS	86.1	80.4	65.3	47.9	86.1	80.4	97.2
	T	-1.935	-1.905	-1.815	-1.68	-1.935	-1.905	-1.987
	SD	.124	.043	.074	.164	.07	.054	.0781
22.8	CS	22.6	24.4	21.4	31.3	34.9	17	22.6
	T	-1.353	-1.387	-1.33	-1.495	-1.543	-1.23	-1.355
	SD	.094	.16	.134	.116	.134	.067	.074

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	33.9	24.8	22.4	23.7	25.3	17	17.7
	T	-1.53	-1.395	-1.35	-1.375	-1.402	-1.23	-1.247
	SD	.074	.038	.142	.08	.058	.029	.033
1.0	CS	60.6	42.4	56.2	67.6	75.9	54	67.6
	T	-1.782	-1.627	-1.75	-1.83	-1.88	-1.732	-1.83
	SD	.128	.174	.047	.068	.034	.035	.072
3.0	CS	179.9	105.3	104.7	140.4	175.8	163.1	149.6
	T	-2.255	-2.023	-2.02	-2.148	-2.245	-2.212	-2.175
	SD	.179	.076	.087	.035	.06	.043	.021
6.0	CS	153.1	100.6	151.4	128.1	168.8	163.1	144.5
	T	-2.185	-2.002	-2.18	-2.107	-2.227	-2.212	-2.16
	SD	.035	.018	.08	.09	.068	.083	.031
11.4	CS	106.5	56.2	106.5	75.4	147.1	109	120.9
	T	-2.028	-1.75	-2.027	-1.877	-2.168	-2.[illegible]	-2.082
	SD	.036	.085	.054	.118	.041	.082	.062
22.8	CS	46	28.3	41.9	33.3	61.7	38.9	54
	T	-1.662	-1.452	-1.622	-1.523	-1.79	-1.59	-1.733
	SD	.123	.043	.029	.144	.076	.067	.026

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	41.7	27.1	25.6	21.3	28.5	19.3	20.2
	T	-1.62	-1.432	-1.407	-1.327	-1.455	-1.285	-1.305
	SD	.146	.062	.062	.048	.057	.079	.102
1.0	CS	57.5	74.1	55.3	68	78.5	74.6	66.5
	T	-1.76	-1.87	-1.742	-1.833	-1.895	-1.872	-1.822
	SD	.039	.054	.062	.028	.0861	.037	.096
3.0	CS	154.9	134.1	128.8	141.3	211.3	133.4	182
	T	-2.19	-2.127	-2.11	-2.15	-2.325	-2.125	-2.26
	SD	.171	.11	.079	.083	.042	.055	.085
6.0	CS	186.2	126.6	142.1	157.6	151.4	157.6	201.8
	T	-2.27	-2.103	-2.152	-2.197	-2.18	-2.197	-2.305
	SD	.117	.064	.66	.026	.027	.057	.146
11.4	CS	100.6	77.2	75	85.6	106.5	94.4	96.6
	T	-2.002	-1.887	-1.875	-1.932	-2.028	-1.975	-1.985
	SD	.023	.134	.072	.133	.043	.12	.072
22.8	CS	46.8	31.1	42.4	39.8	52.5	37.6	42.2
	T	-1.67	-1.493	-1.627	-1.6	-1.72	-1.597	-1.625
	SD	.127	.111	.019	.07	.069	.133	.128

T=Contrast Threshold
SD=Standard Deviation

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RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	15.1	12	14.2	19.4	18.9	15.8	17.8
	T	-1.18	-1.077	-1.152	-1.288	-1.277	-1.2	-1.25
	SD	.107	.07	.118	.016	.075	.07	.019
1.0	CS	62.7	44.8	55.6	52.8	45.4	44.7	40
	T	-1.797	-1.677	-1.745	-1.722	-1.657	-1.65	-1.603
	SD	.057	.053	.054	.103	.046	.077	.035
3.0	CS	97.7	157.6	105.9	139.6	98.9	113.5	84.1
	T	-1.99	-2.197	-2.025	-2.145	-1.995	-2.055	-1.925
	SD	.079	.0861	.103	.105	.081	.023	.0781
6.0	CS	57.5	32.5	47.9	78.1	35.7	37.6	54
	T	-1.76	-1.585	-1.68	-1.892	-1.552	-1.575	-1.733
	SD	.117	.12	.095	.102	.105	.088	.062
11.4	CS	23.2	23.4	22.9	27.9	32.4	29.2	27.4
	T	-1.365	-1.37	-1.36	-1.445	-1.51	-1.465	-1.437
	SD	.038	.032	.017	.12	.072	.113	.083
22.8	CS	12.2	15.9	10.3	17.6	14	12	6.4
	T	-1.085	-1.202	-1.012	-1.245	-1.145	-1.08	-.807
	SD	.101	.026	.143	.062	.087	.121	.122

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	21.3	11	14.1	18.8	19.3	18.8	15.3
	T	-1.327	-1.042	-1.15	-1.275	-1.285	-1.275	-1.185
	SD	.069	.057	.085	.065	.184	.054	.05
1.0	CS	49.8	48.7	43.2	49.8	40.5	55	32.4
	T	-1.697	-1.687	-1.635	-1.697	-1.608	-1.74	-1.51
	SD	.113	.015	.026	.054	.041	.054	.066
3.0	CS	96.1	130.3	85.6	128.1	76.3	141.3	64.2
	T	-1.982	-2.115	-1.932	-2.107	-1.883	-2.15	-1.807
	SD	.104	.057	.115	.143	.0861	.085	.073
6.0	CS	61	113.5	43.7	119.5	34.1	104.1	28.5
	T	-1.785	-2.055	-1.64	-2.077	-1.532	-2.018	-1.455
	SD	.071	.075	.067	.058	.115	.033	.025
11.4	CS	33.9	91.2	20.2	77.2	30	74.6	30.2
	T	-1.53	-1.96	-1.305	-1.887	-1.478	-1.872	-1.48
	SD	.07	.039	.085	.136	.083	.083	.0891
22.8	CS	19.2	30.4	18.2	22.4	13	26.9	18.3
	T	-1.282	1.482	1.26	-1.35	-1.112	-1.43	-1.262
	SD	.125	.048	.258	.067	.065	.076	.096

CS=Contrast Sensitivity Name ______________________

T=Contrast Threshold

SD=Standard Deviation

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RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	16.3	14.5	13.2	22.9	18.1	15.4	18.5
	T	- 1.212	-1.16	-1.12	- 1.36	- 1.257	- 1.187	- 1.267
	SD	.024	.019	.053	.035	.101	.085	.061
1.0	CS	72.4	45.7	38.5	64.2	30.5	40.3	49
	T	- 1.86	- 1.66	- 1.585	- 1.807	- 1.485	- 1.605	- 1.69
	SD	.072	.072	.076	.055	.048	.047	.062
3.0	CS	87.1	138.8	89.6	149.6	89.1	92.8	62
	T	- 1.94	- 2.143	- 1.952	- 2.175	- 1.95	- 1.968	- 1.793
	SD	.056	.101	.013	.072	.094	.108	.083
6.0	CS	55.3	79.9	55	109	85.1	103.5	44.9
	T	- 1.742	- 1.903	- 1.74	- 2.037	- 1.93	- 2.015	- 1.653
	SD	.072	.065	.038	.028	.042	.054	.047
11.4	CS	22.8	51.9	38.2	81.8	41.4	57.2	24.5
	T	- 1.358	- 1.715	- 1.582	- 1.912	- 1.617	- 1.758	- 1.39
	SD	.062	.102	.057	.045	.074	.077	.021
22.8	CS	12.7	9.2	20.5	15.2	17.2	15.9	13.8
	T	- 1.102	- .965	- 1.313	- 1.182	- 1.235	- 1.202	- 1.14
	SD	.102	.075	.041	.03	.126	.046	.081

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	17.3	15.8	21.8	10.9	23.2	15.7	11.7
	T	- 1.237	- 1.2	- 1.337	- 1.038	- 1.365	- 1.195	- 1.067
	SD	.0781	.016	.114	.045	.075	.043	.065
1.0	CS	41.9	41	44.9	44.4	38.7	35.5	46.5
	T	- 1.622	- 1.612	- 1.653	- 1.648	- 1.538	- 1.55	- 1.667
	SD	.058	.053	.064	.07	.05	.041	.092
3.0	CS	118.9	130.3	79	109	109	87.1	94.4
	T	- 2.075	- 2.115	- 1.897	- 2.037	- 2.037	- 1.94	- 1.975
	SD	.051	.129	.162	.103	.111	.051	.059
6.0	CS	80.4	112.2	96.1	112.2	96.1	80.8	78.1
	T	- 1.905	- 2.05	- 1.983	- 2.05	- 1.983	- 1.907	- 1.892
	SD	.022	.061	.048	.061	.048	.048	.031
11.4	CS	30.9	59.6	52.2	59.6	52.2	33.5	26.3
	T	- 1.49	- 1.775	- 1.717	- 1.775	- 1.717	- 1.525	- 1.42
	SD	.037	.036	.129	.036	.129	.115	.051
22.8	CS	12.9	16.4	30.5	16.4	30.5	13.4	10.2
	T	- 1.11	- 1.215	- 1.485	- 1.215	- 1.485	- 1.127	- 1.01
	SD	.087	.021	.102	.021	.102	.04	.048

CS=Contrast Sensitivity

T=Contrast Threshold

SD=Standard Deviation

Name ______________ (10)

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RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	32.7	31.4	21.5	32	30.4	32.5	47.6
	T	-1.515	-1.497	-1.333	-1.505	-1.482	-1.512	-1.677
	SD	.087	.093	.104	.045	.046	.045	.122
1.0	CS	65.7	62.4	62.7	61.8	61.7	51.3	87.1
	T	-1.818	-1.795	-1.797	-1.805	-1.79	-1.71	-1.94
	SD	.034	.027	.088	.033	[illegible]	.041	.063
3.0	CS	163.1	142.9	142.1	127.4	137.2	156.7	150.5
	T	-2.213	-2.155	-2.152	-2.105	-2.138	-2.195	-2.177
	SD	.034	.0781	.037	.054	.059	.068	.026
6.0	CS	216.3	154.9	163.1	167.9	142.9	112.2	138.8
	T	-2.335	-2.19	-2.212	-2.225	-2.155	-2.05	-2.143
	SD	.046	.041	.087	.032	.047	.047	.027
11.4	CS	114.2	109.6	101.2	100	124.5	60.3	109
	T	-2.058	-2.04	-2.005	-2.0	-2.095	-1.78	-2.037
	SD	.066	.041	.118	.025	.032	.083	.031
22.8	CS	48.7	45.4	41.9	26.2	44.7	26.2	55.6
	T	-1.687	-1.657	-1.622	-1.418	-1.65	-1.418	-1.745
	SD	.04	.133	.083	.083	.063	.043	.079

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	32.9	23.6	21.5	43.2	31.4	31.1	35.5
	T	-1.517	-1.373	-1.33.2	-1.635	-1.497	-1.492	-1.55
	SD	.06	.065	.079	.138	.083	.051	.11
1.0	CS	69.2	55.3	53.1	66.1	78.1	66.8	66.1
	T	-1.84	-1.742	-1.725	-1.82	-1.893	-1.825	-1.82
	SD	.045	.057	.08	.035	.04	.034	.012
3.0	CS	128.8	118.2	127.4	117.5	116.8	168.8	140.4
	T	-2.11	-2.072	-2.105	-2.07	-2.067	-2.227	-2.148
	SD	.014	.077	.131	.035	.04	.093	.08
6.0	CS	136.5	113.5	133.4	125.2	135.5	124.5	155.8
	T	-2.135	-2.055	-2.125	-2.097	-2.142	-2,095	-2,192
	SD	.047	.054	.03	.108	.058	.023	.05
11.4	CS	89.1	89.1	105.3	84.6	95.5	73.3	88.6
	T	-1.95	-1.95	2.023	-1.928	-1.98	-1.865	-1.947
	SD	.0861	.065	.061	.071	.024	.059	.054
22.8	CS	46.2	37.2	36.9	23.4	42.4	22.6	35.3
	T	-1.665	-1.57	-1.568	-1.375	-1.628	-1.373	-1.548
	SD	.0781	.065	.029	.061	.055	.041	.044

T=Contrast Threshold
SD=Standard Deviation

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RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	16.1	34.1	36.5	28	34.5	61.7	44.9
	T	-1.208	-1.532	-1.562	-1.447	-1.537	-1.79	-1.652
	SD	.101	.11	.113	.084	.07	.103	.108
1.0	CS	56.9	54.3	51.9	68.4	53.1	101.2	72.9
	T	-1.755	-1.735	-1.715	-1.835	-1.725	-2.005	-1.863
	SD	.063	.095	.107	.042	.112	.027	.092
3.0	CS	113.5	168.8	84.6	133.4	118.2	198.4	102.9
	T	-2.055	-2.228	-1.927	-2.125	-2.072	-2.297	-2.012
	SD	.055	.133	.101	.056	.069	.054	.05
6.0	CS	63.5	148.4	52.8	120.9	52.5	134.9	54.3
	T	-1.802	-2.172	-1.722	-2.082	-1.72	-2.13	-1.735
	SD	.08	.093	.068	.062	.094	.083	.103
11.4	CS	56.2	57.2	41.9	65.7	49.8	72.4	55
	T	-1.75	-1.757	-1.622	-1.818	-1.697	-1.86	-1.74
	SD	.137	.059	.044	.088	.03	.047	.074
22.8	CS	21.8	21.9	20	32.4	26.8	27.9	24.3
	T	-1.337	-1.34	-1.3	-1.51	-1.427	-1.445	-1.385
	SD	.057	.137	.028	.0971	.057	.102	.036

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	38.9	87.1	32	37.8	37.2	49.8	45.7
	T	-1.59	-1.94	-1.505	-1.577	-1.57	-1.697	-1.66
	SD	.231	.119	.085	.128	.061	.062	.073
1.0	CS	109.6	89.1	52.5	59.2	65.3	72.4	60.6
	T	-2.04	-1.95	-1.72	-1.773	-1.815	-1.86	-1.782
	SD	.045	.091	.045	.03	.063	.065	.07
3.0	CS	134.9	158.5	111.6	147.9	139.6	146.2	83.7
	T	-2.13	-2.2	-2.047	-2.17	-2.145	-2.165	-1.922
	SD	.034	.083	.057	.12	.018	.103	.075
6.0	CS	96.6	98.9	74.6	102.9	65.3	147.9	66.5
	T	-1.985	-1.995	-1.872	-2.012	-1.815	-2.17	-1.822
	SD	.047	.09	.0891	.085	.102	.061	.08
11.4	CS	51.9	81.3	54	98.3	57.9	82.7	59.9
	T	-1.715	-1.91	-1.733	-1.992	-1.762	-1.918	-1.777
	SD	.03	.166	.043	.119	.066	.018	.093
22.8	CS	18.2	32.2	28.2	22.8	32	16.7	29.5
	T	-1.26	-1.507	-1.45	-1.358	-1.505	1.222	1.47
	SD	.083	.15	.029	.1	.093	.082	.098

CS=Contrast Sensitivity Name ______ (12)
T=Contrast Threshold
SD=Standard Deviation

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RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	22.4	27.7	34.9	26.8	25.4	27.9	32
	T	-1.35	-1.443	-1.542	-1.427	-1.405	-1.445	-1.505
	SD	.076	.07	.114	.094	.073	.059	.084
1.0	CS	80.4	98.9	52.2	75.4	54.3	88.1	72
	T	1.905	-1.995	-1.717	-1.877	-1.735	-1.945	-1.858
	SD	.113	.103	.091	.047	.0861	.103	.085
3.0	CS	132.6	171.8	102.3	115.5	91.2	114.2	105.3
	T	-2.122	-2.235	-2.01	-2.063	-1.96	-2.058	-2.023
	SD	.033	.117	.056	.027	.0891	.06	.036
6.0	CS	116.1	98.3	80.8	87.6	63.1	93.9	75
	T	-2.065	-1.992	-1.907	-1.942	-1.8	-1.972	-1.875
	SD	.13	.081	.084	.044	.067	.095	.068
11.4	CS	50.1	52.5	42.7	35.5	36.7	49.8	38.9
	T	-1.7	-1.72	-1.63	-1.55	-1.565	-1.697	-1.59
	SD	.072	.125	.1	.049	.052	.079	.065
22.8	CS	26.6	23.9	22.4	20.9	14.6	16.9	17
	T	-1.425	-1.377	-1.36	-1.32	-1.165	-1.227	-1.23
	SD	.065	.156	.073	.102	.067	.0861	.054

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	36.1	30	36.1	29.7	28.2	25.1	35.7
	T	-1.557	-1.477	-1.557	-1.472	-1.45	-1.4	-1.552
	SD	.0861	.148	.106	.056	.064	.103	.095
1.0	CS	96.1	56.2	61.3	46.2	52.5	64.9	70.8
	T	-1.982	-1.75	-1.787	-1.655	-1.72	-1.813	-1.85
	SD	.075	.117	.062	.045	.082	.051	.12
3.0	CS	123	136.5	105.4	110.3	112.2	107.8	110.3
	T	-2.09	-2.135	-2.025	-2.042	-2.05	-2.032	-2.042
	SD	.11	.023	.05	.07	.037	.036	.061
6.0	CS	115.5	100.6	93.9	95	70	97.2	74.6
	T	-2.062	-2.002	-1.973	-1.977	-1.845	-1.987	-1.873
	SD		.035	.065	.032	.057	.033	.123
11.4	CS	53.7	55.9	39.6	52.5	42.2	49.5	43.7
	T	-1.73	-1.747	-1.597	-1.72	-1.625	-1.695	-1.64
	SD	.0781	.076	.043	.076	.109	.057	.079
22.8	CS	27.4	26.5	22.3	18.7	13.1	10.7	24.4
	T	-1.437	-1.422	-1.347	-1.272	-1.118	-1.03	-1.387
	SD	.044	.092	.14	.06	.099	.113	.082

T=Contrast Threshold
SD=Standard Deviation

(13)

50M

RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	19.6	17.1	20.5	27.9	27.1	24.8	18.2
	T	-1.245	-1.232	-1.312	-1.445	-1.433	-1.395	-1.26
	SD	.133	.043	.047	.052	.033	.043	.025
1.0	CS	53.7	63.5	54	73.7	61	57	42.2
	T	-1.73	-1.802	-1.732	-1.867	-1.785	-1.707	-1.625
	SD	.102	.053	.088	.077	.142	.029	.071
3.0	CS	128.1	116.8	107.2	128.1	166.9	112.8	98.3
	T	-2.107	-2.067	-2.05	-2.107	-2.222	-2.052	-1.992
	SD	.142	.082	.066	.125	.131	.061	.09
6.0	CS	92.3	112.2	90.2	101.7	119.5	88.6	78.5
	T	-1.965	-2.05	-1.955	-2.007	2.077	-1947	-1.895
	SD	.054	.068	.035	.054	.051	.079	.069
11.4	CS	47.9	39.4	56.6	64.6	61.7	55	38.2
	T	-1.68	-1.595	-1.752	-1.81	-1.79	-1.74	-1.582
	SD	.074	.027	.107	.053	.051	.034	.06
22.8	CS	23.6	15.4	22.9	26.5	30	24.5	16.6
	T	-1.373	-1.188	-1.36	-1.422	-1.477	-1.39	-1.22
	SD	.0781	.063	.091	.047	.033	.037	.055

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	18.8	22.4	24.3	29.9	22.4	35.9	19.3
	T	-1.275	-1.35	-1.385	-1.475	-1.35	-1.555	-1.235
	SD	.096	.027	.106	.025	.064	.123	.0781
1.0	CS	57.9	60.3	42.2	56.9	55	44.2	48.7
	T	-1.762	-1.78	-1.625	-1.755	-1.74	-1.645	-1.687
	SD	.085	.098	.045	.046	.041	.049	.04
3.0	CS	177.8	141.3	126.6	134.1	96.6	103.5	98.9
	T	-2.25	-2.15	-2.103	-2.127	-1.985	-2.015	-1.995
	SD	.195	.057	.054	.036	.067	.096	.056
6.0	CS	118.2	121.6	115.5	118.2	93.3	102.9	91.2
	T	-2.072	-2.085	-2.063	-2.072	-1.97	-2.012	-1.96
	SD	.03	.119	.054	.099	.056	.051	.03
11.4	CS	66.1	47.6	57.6	58.5	54	38.9	45.4
	T	-1.82	-1.677	-1.775	-1.767	-1.732	-1.59	-1.657
	SD	.121	.095	.035	.08	.069	.081	.043
22.8	CS	30.5	18.5	17.8	20.3	24	20.7	13
	T	-1.485	1.268	1.25	-1.707	-1.38	-1.315	-1.112
	SD	.113	.04	.099	.105	.082	.084	.133

CS=Contrast Sensitivity Name
T=Contrast Threshold
SD=Standard Deviation

(14)

50N

RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	20.2	18.4	30.2	32.7	37.4	25.6	40.5
	T	-1.305	-1.685	-1.48	-1.515	-1.572	-1.407	-1.608
	SD	.067	.093	.085	.096	.087	.079	.063
1.0	CS	100.6	96.6	70.4	70.8	92.8	76.3	79.4
	T	-2.007	-1.985	-1.847	-1.85	-1.968	-1.883	-1.9
	SD	.111	.115	.107	.064	.067	.056	.053
3.0	CS	154.9	196.1	169.8	191.6	150.5	185.1	139.6
	T	-2.19	-2.292	-2.23	-2.282	-2.177	-2.268	-2.145
	SD	.044	.074	.08	.025	.047	.031	.015
6.0	CS	152.2	132.6	147.9	182	128.8	184.1	151.4
	T	-2.182	-2.122	-2.17	-2.26	-2.11	-2.265	-2.18
	SD	.045	.134	.055	.048	.043	.03	.031
11.4	CS	96.1	56.2	92.3	60.3	90.2	67.6	75.4
	T	-1.983	-1.75	-1.965	-1.78	-1.955	-1.83	-1.877
	SD	.035	.035	.062	.065	.076	.051	.059
22.8	CS	33.5	13.4	17.1	12	15.6	13.8	25.9
	T	-1.525	-1.127	-1.232	-1.08	-1.192	-1.14	-1.412
	SD	.106	.088	.09	.045	.091	.072	.052

LEFT EYE

.5	CS	33.9	26.3	29.5	28.3	35.1	34.1	26.3
	T	-1.53	-1.42	-1.47	-1.452	-1.545	-1.532	-1.42
	SD	.134	.1	.128	.079	.113	.09	.127
1.0	CS	76.3	57.2	72.4	52.2	92.8	70.4	50.1
	T	-1.883	-1.757	-1.86	-1.717	-1.968	-1.847	-1.7
	SD	.073	.06	.132	.036	.195	.044	.045
3.0	CS	186.2	197.2	136.5	185.1	175.8	190.5	130.3
	T	-2.27	-2.295	-2.135	-2.268	-2.245	-2.28	-2.115
	SD	.052	.027	.0781	.088	.123	.102	.059
6.0	CS	138	199.5	188.4	128.1	142.1	130.3	131.1
	T	-2.14	-2.3	-2.275	-2.107	-2.152	-2.115	-2.117
	SD	.025	.039	.094	.037	.029	.069	.019
11.4	CS	76.7	97.7	51	87.6	39.6	102.9	53.4
	T	-1.885	-1.99	-1.707	-1.943	-1.597	-2.012	-1.727
	SD	.048	.051	.093	.049	.028	.101	.08
22.8	CS	25	20	13.6	25.3	17.8	17.2	11
	T	-1.398	-1.3	-1.135	-1.402	-1.25	-1.235	-1.042
	SD	.084	.087	.071	.074	.068	.074	.191

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	17.7	11.5	8.6	10.5	13.5	10.7	13.9
	T	-1.248	-1.06	-.935	-1.023	-1.13	-1.03	-1.143
	SD	.153	.021	.054	.095	.025	.035	.083
1.0	CS	48.1	22.9	24.5	33.3	44.7	36.5	44.7
	T	-1.682	-1.36	-1.39	-1.523	-1.65	-1.562	-1.65
	SD	.055	.091	.091	.07	.033	.093	.023
3.0	CS	126.6	40.7	96.1	79.9	116.1	74.1	120.9
	T	-2.103	-1.61	-1.982	-1.903	-2.065	-1.87	-2.082
	SD	.047	.076	.107	.052	.011	.069	.055
6.0	CS	102.9	38.5	75.9	78.1	115.5	39.8	128.1
	T	-2.012	-1.585	-1.88	-1.892	-2.062	-1.6	-2.107
	SD	.06	.044	.046	.058	.14	.037	.0971
11.4	CS	51.3	14.5	47.3	20.9	44.4	25	50.4
	T	-1.71	-1.16	-1.675	-1.32	-1.648	-1.397	-1.702
	SD	.047	.066	.049	.161	.114	.13	.068
22.8	CS	18.7	5.9	12.8	12.6	16.6	14.9	19.2
	T	-1.272	-.767	-1.107	-1.1	-1.22	-1.172	-1.282
	SD	.0891	.035	.06	.055	.145	.029	.149

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	11	9.5	9.3	11	11.9	14.8	13.5
	T	-1.04	-.977	-.97	-1.042	-1.075	-1.17	-1.13
	SD	.06	.025	.045	.115	.073	.085	.022
1.0	CS	25.9	25.1	30.5	26.3	32.4	45.2	29.2
	T	-1.412	-1.4	-1.435	-1.42	-1.51	-1.655	-1.465
	SD	.051	.071	.054	.081	.032	.025	.07
3.0	CS	98.9	79.4	80.4	117.5	62.4	100.6	108.4
	T	-1.995	-1.9	-1.905	-2.07	-1.795	-2.002	-2.035
	SD	.069	.046	.069	.102	.052	.0971	.115
6.0	CS	92.3	57.9	59.6	78.5	100	105.3	82.7
	T	-1.965	-1.762	-1.775	-1.895	-2.0	-2.023	-1.917
	SD	.059	.061	.036	.063	.042	.046	.06
11.4	CS	36.7	38.9	39.6	47	45.7	37.4	61.3
	T	-1.565	-1.59	-1.597	-1.672	-1.66	-1.572	-1.787
	SD	.063	.023	.039	.028	.065	.067	.036
22.8	CS	20.3	18.7	15.4	14.2	21.8	14.5	30.9
	T	-1.307	-1.273	-1.188	-1.152	-1.337	-1.162	-1.49
	SD	.094	.098	.0861	.113	.112	.105	.114

T=Contrast Threshold
SD=Standard Deviation

(16)

50P

RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	51.6	77.2	87.1	82.7	95	74.6	53.1
	T	-1.713	-1.887	-1.94	-1.918	-1.977	-1.872	-1.725
	SD	.146	.122	.043	.14	.071	.06	.108
1.0	CS	91.2	127.4	131.8	134.9	195	147.9	132.6
	T	-1.96	-2.105	-2.12	-2.13	-2.29	-2.17	-2.122
	SD	.0891	.095	.109	.047	.106	.082	.051
3.0	CS	149.6	175.8	142.1	164.1	189.5	207.7	198.4
	T	-2.175	-2.245	-2.152	-2.215	-2.277	-2.317	-2.297
	SD	.03	.127	.043	.038	.106	.121	.09
6.0	CS	154	163.1	118.2	168.8	147.1	169.8	130.3
	T	-2.188	-2.213	-2.072	-2.228	-2.167	-2.23	-2.115
	SD	.04	.029	.073	.061	.063	.167	.05
11.4	CS	88.6	102.3	93.9	100.6	104.1	107.2	89.6
	T	-1.948	-2.01	-1.972	-2.002	-2.018	-2.03	-1.952
	SD	.093	.049	.115	.055	.057	.05	.0891
22.8	CS	49	52.5	47.6	45.2	72	57.5	44.7
	T	-1.69	-1.72	-1.677	-1.655	-1.857	-1.76	-1.65
	SD	.083	.08	.094	.104	.104	.09	.08

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	68.4	64.9	55.3	52.8	57.2	75	59.2
	T	-1.835	-1.813	-1.742	-1.722	-1.758	-1.875	-1.773
	SD	.144	.222	.104	.054	.141	.182	.144
1.0	CS	92.8	112.2	85.1	134.1	129.6	100	110.9
	T	-1.967	-2.05	-1.93	-2.128	-2.112	-2.0	-2.045
	SD	.041	.041	.039	.079	.065	.037	.083
3.0	CS	207.7	133.4	166	134.1	193.9	131.8	278.6
	T	-2.317	-2.125	-2.22	-2.127	-2.287	-2.12	-2.445
	SD	.024	.063	.014	.116	.025	.128	.061
6.0	CS	142.9	103.5	140.4	134.1	147.1	116.8	112.8
	T	-2.155	-2.015	-2.147	-2.127	-2.167	-2.067	-2.053
	SD	.121	.063	.041	.052	.092	.065	.054
11.4	CS	92.3	86.1	106.5	91.2	96.1	56.9	75
	T	-1.965	-1.935	-2.028	-1.96	-1.982	-1.755	-1.825
	SD	.03	.056	.0891	.08	.088	.084	.047
22.8	CS	67.2	41.2	39.4	50.7	51.9	31.6	33.3
	T	-1.827	-1.615	-1.595	-1.705	-1.715	-1.5	-1.522
	SD	.087	.057	.047	.049	.049	.0891	.044

CS=Contrast Sensitivity Name______________

T=Contrast Threshold

SD=Standard Deviation

(17)

50Q

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	21.8	49	31.6	36.7	26.5	29.7	34.5
	T	-1.337	-1.69	-1.5	-1.565	-1.422	-1.472	-1.537
	SD	.062	.112	.067	.154	.102	.035	.0781
1.0	CS	40	64.6	62.4	63.1	38.5	45.7	52.2
	T	-1.602	-1.81	-1.795	-1.8	-1.585	-1.657	-1.717
	SD	.073	.145	.085	.036	.093	.011	.043
3.0	CS	92.8	137.2	129.6	98.9	74.1	110.3	82.2
	T	-1.968	-2.138	-2.112	-1.995	-1.87	-2.042	-1.915
	SD	.095	.032	.041	.075	.027	.033	.022
6.0	CS	53.7	134.1	110.3	91.7	70.4	69.6	75.9
	T	-1.73	-2.127	-2.042	-1.963	-1.847	-1.843	-1.88
	SD	.057	.033	.018	.048	.019	.02	.052
11.4	CS	40.7	72.4	66.8	52.5	49	63.1	52.4
	T	-1.61	-1.86	-1.825	-1.72	-1.69	-1.8	-1.727
	SD	.049	.067	.126	.012	.082	.056	.04
22.8	CS	24.8	40.7	37.4	33.7	38	33.1	28.8
	T	-1.395	-1.61	-1.572	-1.527	-1.58	-1.52	-1.46
	SD	.03	.021	.061	.074	.06	.037	.042

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	31.1	48.1	28.2	32.2	29.2	21.1	19.4
	T	-1.493	-1.682	-1.45	-1.507	-1.465	-1.325	-1.288
	SD	.106	.156	.137	.066	.084	.074	.049
1.0	CS	75	56.6	63.1	40.3	40	36.3	42.4
	T	-1.875	-1.753	-1.8	-1.605	-1.603	-1.56	-1.627
	SD	.077	.039	.0861	.08	.033	.047	.085
3.0	CS	88.1	105.9	95	84.6	75.4	75	68.8
	T	-1.945	-2.025	-1.977	-1.927	-1.877	-1.875	-1.837
	SD	.032	.061	.083	.043	.036	.063	.092
6.0	CS	86.6	104.1	87.6	72	67.6	79.9	70
	T	-1.937	-2.017	-1.942	-1.857	-1.83	-1.903	-1.845
	SD	.038	.0891	.046	.103	.037	.043	.038
11.4	CS	56.9	62.7	55.9	44.4	52.5	49.3	56.9
	T	-1.755	-1.798	-1.747	-1.647	-1.72	-1.693	-1.755
	SD	.054	.07	.104	.07	.081	.18	.055
22.8	CS	37.8	38.9	26	28.8	37.4	23.7	21.4
	T	-1.577	-1.59	-1.415	-1.46	-1.572	-1.325	-1.33
	SD	.12	.096	.063	.037	.081	.038	.051

T=Contrast Threshold
SD=Standard Deviation

50R

RIGHT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	23	26	33.3	33.1	18.5	26.6	18.1
	T	-1.362	-1.415	-1.523	-1.52	-1.267	-1.425	-1.257
	SD	.156	.0971	.092	.125	.095	.062	.019
1.0	CS	34.9	58.9	54.9	41	38.7	38.9	43.4
	T	-1.542	-1.77	-1.777	-1.612	-1.587	-1.59	-1.637
	SD	.124	.082	.046	.055	011	.09	.069
3.0	CS	121.6	125.2	133.4	89.6	133.4	119.5	100
	T	-2.085	-2.097	-2.125	-1.952	-2.125	-2.077	-2.0
	SD	.03	.045	.038	.043	.064	.018	.055
6.0	CS	121.6	88.6	118.9	87.1	133.4	75.9	140.4
	T	-2.085	-1.947	-2.075	-1.94	-2.125	-1.88	-2.148
	SD	.118	.023	.101	.091	.07	.1	.04
11.4	CS	58.2	19.1	64.2	63.5	94.4	41.7	77.6
	T	-1.765	-1.28	-1.807	-1.802	-1.975	-1.62	-1.89
	SD	.042	.047	.035	.058	.035	.124	.064
22.8	CS	34.9	11.6	13.7	12.7	33.5	18.6	26.8
	T	-1.543	-1.065	-1.137	-1.103	-1.525	-1.27	-1.428
	SD	.071	.092	.117	.171	.077	.111	.023

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	18.7	43.2	23.4	28.7	16.7	31.3	18.5
	T	-1.273	-1.635	-1.377	-1.458	-1.222	-1.495	-1.267
	SD	.083	.093	.142	.13	.043	.0781	.049
1.0	CS	30.9	57.2	42.7	47.9	35.5	35.7	31.8
	T	-1.49	-1.757	-1.63	-1.68	-1.55	-1.552	-1.502
	SD	.096	.076	.035	.079	.045	.076	.103
3.0	CS	94.4	125.2	125.2	138.8	105.9	93.3	79
	T	-1.975	-2.097	-2.097	-2.143	-2.025	-1.97	-1.898
	SD	.059	.07	.065	.0861	.051	.121	.055
6.0	CS	151.4	108.4	128.8	112.8	131.8	116.8	89.6
	T	-2.18	-2.035	-2.11	-2.052	-2.12	-2.067	1.953
	SD	.052	.121	.062	.127	.063	.036	.081
11.4	CS	70.8	51.6	64.6	62	69.2	57.5	78.1
	T	-1.85	-1.713	-1.81	-1.793	-1.84	-1.76	-1.842
	SD	.072	.068	.112	.068	.118	.146	.084
22.8	CS	26.3	30.2	24.8	26	31.3	24.7	32
	T	-1.42	-1.48	-1.395	-1.415	-1.495	-1.393	-1.505
	SD	.078	.052	.05	.056	.074	.104	.0781

T=Contrast Threshold
SD=Standard Deviation

RIGHT EYE

Spatial Frequency		Baseline	Dispensing		One Week		One Month	
			CL	Removed	CL	Removed	CL	Removed
.5	CS	8.2	13.4	18.4	16.6	16	20.4	18.2
	T	- .915	- 1.127	- 1.265	- 1.22	- 1.205	- 1.31	- 1.26
	SD	.0891	.053	.117	.098	.076	.057	.121
1.0	CS	41.9	37.2	44.7	55	41.7	43.4	46
	T	- 1.622	- 1.57	- 1.65	- 1.74	- 1.62	- 1.637	- 1.662
	SD	.052	.083	.068	.082	.059	.028	.065
3.0	CS	81.3	101.7	101.2	95.5	121.6	107.8	92.8
	T	- 1.91	- 2.008	- 2.005	- 1.98	- 2.085	- 2.032	- 1.968
	SD	.0861	.098	.021	.035	.125	.112	.055
6.0	CS	89.6	88.1	97.2	74.1	88.1	90.7	101.7
	T	- 1.952	- 1.945	- 1.987	- 1.87	- 1.945	- 1.957	- 2.007
	SD	.109	.113	.072	.083	.072	.098	.054
11.4	CS	45.2	34.7	47	30	45.2	56.6	62.4
	T	- 1.655	- 1.54	- 1.673	- 1.477	- 1.655	- 1.752	- 1.795
	SD	.108	.016	.0861	.048	.071	.0861	.131
22.8	CS	15.8	12	24	18.1	21.6	23.7	26.6
	T	- 1.2	- 1.077	- 1.38	- 1.257	- 1.335	- 1.375	- 1.425
	SD	.112	.068	.106	.181	.126	.129	.117

LEFT EYE

Spatial Frequency		Baseline	Dispensing CL	Dispensing Removed	One Week CL	One Week Removed	One Month CL	One Month Removed
.5	CS	13.5	16.2	15.8	14.3	18.9	18.6	18.7
	T	- 1.13	- 1.21	- 1.2	- 1.155	- 1.277	- 1.27	- 1.272
	SD	.03	.083	.043	.105	.029	.07	.033
1.0	CS	42.7	33.3	51.6	52.5	31.4	57	47
	T	- 1.63	- 1.523	- 1.713	- 1.72	- 1.497	- 1.707	- 1.672
	SD	.105			.074	.023	.069	.08
3.0	CS	80.4	84.1	92.8	97.2	86.6	104.1	87.1
	T	- 1.905	- 1.925	- 1.968	- 1.985	- 1.937	- 2.018	- 1.94
	SD	.088	.061	.094	.047	.031	.085	.0781
6.0	CS	90.7	75.4	92.3	102.3	77.2	110.9	128.5
	T	- 1.957	- 1.878	- 1.965	- 2.01	- 1.887	- 2.045	- 2.11
	SD	.084	.103	.0971	.039	.038	.109	.121
11.4	CS	52.5	32.9	67.2	49	56.2	72	67.2
	T	- 1.72	- 1.517	- 1.827	- 1.69	- 1.75	- 1.855	- 1.827
	SD	.091	.084	.0971	.099	.031	.052	.05
22.8	CS	19.2	16.3	32	18.9	13.6	18.4	35.9
	T	- 1.282	- 1.212	- 1.505	- 1.277	- 1.132	- 1.265	- 1.555
	SD	.098	.051	.044	.098	.018	.032	.082

APPENDIX K

DEFINITIONS OF TERMS

contrast sensitivity - the logarithm of the reciprocal contrast threshold.

contrast sensitivity function - the curve generated by plotting contrast sensitivity against spatial frequency on a log-log scale. It is obtained by measuring the sensitivity for the discrimination of a sine-wave grating from an homogeneous field at each of several spatial frequencies.

contrast threshold - the difference between maximum and minimum grating luminance divided by the sum of the maximum and minimum luminance when the grating is barely visible.

$$\text{contrast threshold} = \frac{Lmax - Lmin}{Lmax + Lmin}$$

spatial frequency - the number of light-and-dark bar pairs per degree of visual angle subtended. Usually referred to in cycles/degree.