Bayesian Adaptive Contrast Sensitivity Function as a Sensitive Indicator of Diabetic Macular Edema

View Session Detail | Print Abstract

Posterboard #: A0114

Abstract Number: 935 - A0114

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Disclosure Block: Lloyd P. Aiello, Adaptive Sensory Technology (Code F (Financial Support)); Jae Rhee, None; Luis A. Lesmes, Adaptive Sensory Technology (Code E (Employment)); Ava K. Bittner, Adaptive Sensory Technology (Code F (Financial Support)); Jennifer K. Sun, Adaptive Sensory Technology (Code F (Financial Support))

Purpose: To characterize Bayesian adaptive estimation of the contrast sensitivity function (BCSF) as a novel assessment in diabetic (DM) and nondiabetic (nonDM) individuals across a wide range of diabetic retinopathy (DR) and diabetic macular edema (DME) severity.

Methods:DM and nonDM subjects underwent undilated binocular BCSF testing by a trained technician using a Sentio system with NEC P463 professional-grade flat panel which displays contrast levels from 0.2%-100% and stimulus sizes from 1-27 cycles/degree (cpd) at 3m. Area under the letter/contrast size curve (AULCSF) and Contrast Sensitivity Function (CSF) Acuity were estimated using 25 trials and a broad spectrum of spatial frequencies (1, 1.5, 3, 6, 12 and 18 cpd). Optos 200° fundus photos and spectral domain OCT were performed at the same visit and graded for DR and DME severity by graders masked to BCSF outcomes.

Results: Of 111 participants, 61 had type 1 or 2 DM and 50 were age matched without DM. BCSF test-retest repeatability was excellent in both DM and nonDM. AULCSF decreased significantly with age and DM, but was not related to gender, DM type, DM duration or A1c. Compared to DM participants without DME, those with DME were more likely to have reduced AULCSF (1.08 vs 1.46, p <0.0001), CSF Acuity (1.22 vs 1.36, p=0.003), and CS across all spatial frequencies (p<0.0001-0.01). BCSF parameters were incrementally reduced by DME in no, 1 or both eyes: AULCSF (1.46 vs 1.26 vs 0.87, p <0.001), CSF Acuity (1.36 vs 1.30 vs 1.12, p=0.0002) and CS across all spatial frequencies (p=<0.0001-0.006). In multivariable models adjusting for age and visual acuity in the worse or better-seeing eye, all binocular CSF parameters remained significantly associated with DME status.

Conclusions: Current CS methods such as the Pelli Robson Chart, test limited spatial frequencies and do not correlate well with diabetes or diabetic retinal disease. The BCSF method provides precise CSF estimation over a wide range of spatial frequencies, resulting in a two-dimensional contour defining the lowest contrast distinguished at each spatial frequency. These data suggest that BCSF may be a sensitive method to detect DME-induced visual function changes independent of age and visual acuity. Further study is warranted to determine if BCSF can be used as an early functional marker of diabetic retinopathy or response to therapy.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

Binocular contrast suppression in patients with glaucoma

View Session Detail | Print Abstract

Posterboard #: B0569

Abstract Number: 4662 - B0569

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Disclosure Block: Pujan Dave, None; Luis A. Lesmes, Adaptive Sensory Technology (Code E (Employment)), Adaptive Sensory Technology (Code P (Patent)), Adaptive Sensory Technology (Code I (Personal Financial Interest)); David S. Friedman, None; Pradeep Ramulu, None

Purpose: Prior research suggests that binocular measures of vision equal or exceed measures obtained from each eye individually. Anecdotally, however, glaucoma patients sometimes express that a poorly-seeing eye can depress their binocular vision below the level of their better-seeing eye, a phenomenon referred to as suppression. We performed a cross-sectional, clinical study to look for evidence of suppression in a glaucoma population.

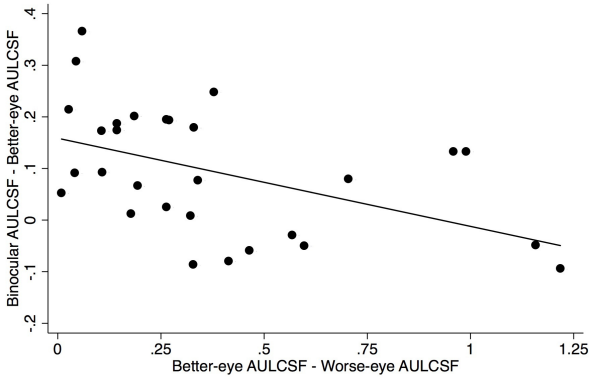
Methods: The contrast sensitivity function (CSF), measuring contrast sensitivity at varying letter sizes to model the area under the curve log CSF (AULCSF), was evaluated in 29 primary glaucoma patients with varied disease severity using the qCSF testing device (Adaptive Sensory Technology). Testing was performed in monocular and binocular conditions. Regression models were constructed in which the binocular - better-eye AULCSF difference was the dependent variable, inter-eye AULCSF difference was the independent variable, and age was a covariate. Patients were said to have a small inter-eye difference if right and left eye AULCSF values were within 0.3 and a large inter-eye difference if the values differed by more than 0.3.

Results: Subjects had a mean age of 69.6 (1.7) years and an average visual field mean deviation of -5.9 (1.4) and -13.1 (1.5) in the better and worse eyes, respectively. For all subjects, binocular AULCSF was 0.10 (0.12) greater than better-eye AULCSF. In the 15 patients with a small inter-eye difference, binocular AULCSF was 0.16 (0.13) greater than better-eye AULCSF, while in the 14 patients with a large inter-eye difference, binocular AULCSF was 0.03 (0.11) greater than better-eye AULCSF (p=0.003). No patient with a small inter-eye difference had worse binocular than better-eye AULCSF, while 7 of 14 patients with a large inter-eye difference had worse binocular than better-eye AULCSF (p<0.001). In regression models, each 0.1 increment in inter-eye AULCSF difference was associated with a 0.02 decrement in binocular - better-eye AULCSF difference (95% CI -0.03 to -0.002, p=0.024) and 1.43 higher odds of a worse binocular than better-eye AULCSF (95% CI 1.06 to 1.93, p=0.018).

Conclusions: Glaucoma patients with large visual differences from a poorly-seeing eye may experience suppression of vision in their better eye and lose binocular advantage when testing CSF. Better-eye monocular visual measures may not be an accurate representation of binocular vision in glaucoma patients.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.: People often have one eye that sees better than their other eye. When people use both eyes together to see, they can typically see as good as they can with their better eye alone, and sometimes even better than that. However, some patients with glaucoma say that their worse eye makes their better eye see worse. Those patients feel that their vision using both eyes is worse than with their better eye alone. This phenomenon is referred to as “suppression”.

Suppression is known to occur in conditions such as lazy eye, but until now was not known to occur in glaucoma. We discovered that glaucoma patients may also experience suppression. In other words, the patients were right: glaucoma patients’ worse eye might, in fact, make their better eye see worse. This could explain why some glaucoma patients say their vision is worse than ophthalmologists previously expected it to be. This also means that the “better eye” might not be an accurate way of predicting how well a glaucoma patient can see. Most importantly, knowing that suppression might exist in glaucoma offers a new way to understand how glaucoma affects vision, to follow patients over time, and to provide better treatment.


Binocular AULCSF - Better-eye AULCSF
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.5
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Better-eye AULCSF - Worse-eye AULCSF

Deficient Contrast Sensitivity Function in Regular Astigmatic Eyes with Normal or Corrected-to-Normal Visual Acuity

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Posterboard #: B0675

Abstract Number: 4214 - B0675

Author Block: *Jinrong Li[1] , Jin Yuan[1] , Fang Hou[2] , Michael Dorr[3] , Zhong-lin Lu[4]*
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Disclosure Block: Jinrong Li, None; Jin Yuan, None; Fang Hou, None; Michael Dorr, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent)); Zhong-lin Lu, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent))

Purpose: The contrast sensitivity function (CSF) provides a more comprehensive measure in functional vision compared to visual acuity. This study investigates the visual quality of regular astigmatic subjects with normal or corrected-to-normal visual acuity by evaluating their CSF and ocular optical performance.

Methods:A total of 40 eyes of patients (ages 15-29 years old) with regular astigmatism either with normal acuity or corrected-to-normal acuity with their full spectacle corrections, and 34 healthy eyes of individuals (ages 22-30 years old) without astigmatism participated in this study. The cutoff spatial frequency (cutoff SF) and the area under log CSF (AULCSF) in CSF were derived with the quick CSF method (Lesmes, et al, 2010; Hou, et al, 2015). The MTF cutoff frequency (MTF_{cutoff}), $Strehl^{2D}$ ratio, OQAS values (OVs) at 100%, 20%, and 9% contrasts, and objective scatter index (OSI) were used to assess the optical quality of the studied eyes by the Optical Quality Analysis System (OQAS).

Results: The average astigmatism was 2.56±0.84 D (1.50-4.50 D) in the astigmatic eyes. The MTF_{cutoff} (29.28±15.55 c/d) of the astigmatic eyes was significantly lower than that of the normal eyes (40.48±11.68 c/d) ($p<0.001$). The $Strehl^{2D}$ ratio was less in astigmatic eyes (0.18±0.09) than that of the normal eyes (0.23±0.08) ($p<0.01$). OV $_{100\%, 20\% \text{ and } 9\%}$ and OSI were significantly smaller in the astigmatic eyes compared to normal (all $p<0.05$). Moreover, the cutoff SF in the astigmatic eyes was significantly lower (14.36±4.32 c/d) than that in the normal eyes (17.82±5.48 c/d) ($p < 0.001$). The AULCSF was reduced in astigmatic (1.15±0.28) versus normal eyes (1.35±0.17) ($p<0.01$). Most importantly, for patients with regular astigmatism, although visual acuity was not correlated with any optical performance measure, the AULCSF negatively correlated with the degree of astigmatism and the $Strehl^{2D}$ ratio ($r=-0.3223$ and -0.3745; $p<0.05$), and the cutoff SF correlated with the degree of astigmatism ($r=0.3553$; $p<0.05$).

Conclusions: Astigmatic eyes exhibited deficient contrast sensitivity function and optical transmission, even under full optical correction. The contrast sensitivity function is an important clinical management factor in assessing astigmatism correction in addition to visual acuity, even for individuals with normal uncorrected visual acuity.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

Distinguishing the contribution of precision and repeatability to vision testing

View Session Detail | Print Abstract

Posterboard #: A0342

Abstract Number: 2204 - A0342

Author Block: *Luis A. Lesmes[1] , Ava K. Bittner[2] , Zhong-Lin Lu[3] , Peter J. Bex[4] , Michael Dorr[5]*
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Disclosure Block: Luis A. Lesmes, Adaptive Sensory Technology Inc (Code I (Personal Financial Interest)), Adaptive Sensory Technology Inc (Code E (Employment)), Adaptive Sensory Technology Inc (Code P (Patent)); Ava K. Bittner, Adaptive Sensory Technology Inc (Code F (Financial Support)); Zhong-Lin Lu, Adaptive Sensory Technology Inc (Code P (Patent)), Adaptive Sensory Technology Inc (Code I (Personal Financial Interest)); Peter J. Bex, Adaptive Sensory Technology Inc (Code I (Personal Financial Interest)), Adaptive Sensory Technology Inc (Code P (Patent)); Michael Dorr, Adaptive Sensory Technology Inc (Code I (Personal Financial Interest)), Adaptive Sensory Technology Inc (Code P (Patent))

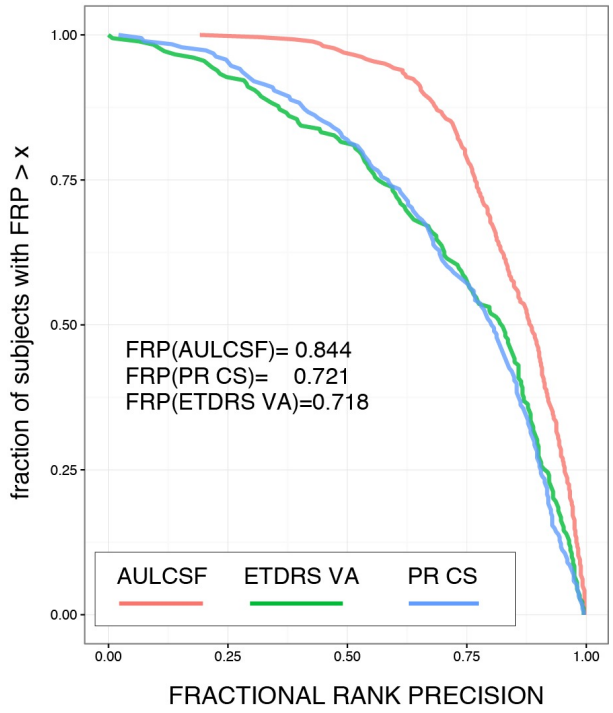
Purpose: The promise of visual health monitoring and personalized medicine depends on vision metrics that can precisely track an individual's vision over time. Common proxies for test precision are based on repeatability, such as the coefficient of repeatability (CoR). However, precision and repeatability are not the same. A test with coarse resolution may be repeatable, but changes in vision within or between individuals are obscured by large steps between test scores. To address this confound, we developed a new Fractional Rank Precision (FRP) metric to evaluate the precision of visual testing, based on concepts of machine learning: how well can an individual be identified in the population distribution of retest measures, based on their initial test measure? We assessed 3 vision tests using FRP: ETDRS visual acuity (VA), Pelli-Robson (PR) contrast sensitivity (CS), and quick Contrast Sensitivity Function (qCSF) testing.

Methods: From healthy observers (20-85 years), we obtained 164 monocular and 100 binocular test-retest pairs of qCSF (one week apart). For a broad, scalar summary statistic, we computed the Area Under the Log CSF (AULCSF) from 1.5 to 18 cycles per degree. We also collected 189/180 test-retest pairs from PR CS and ETDRS VA testing. For each test, we computed CoR and FRP: the rank of the retest of a subject when all subjects' retests are sorted by their similarity to a subject's initial test, averaged across all subjects. FRP ranges from .5 (chance) to 1.0 (perfect identification of test from retest for each subject). We also recomputed FRP for increasing quantization, i.e. rounding of values to coarse step sizes.

Results: CoR and FRP were .214 and .844 (AULCSF), .243 and .721 (PR CS), and .149 and .718 (ETDRS VA), respectively. As expected, increasing quantization reduced FRP. The precision of AULCSF was reduced to that of unmodified (non-quantized) PR CS and ETDRS VA, when strong quantization collapsed the AULCSF population distribution to only 5 step-sizes.

Conclusions: The FRP metric is sensitive to a test's resolution (step-size), variability (CoR), and dynamic range. Despite apparently better repeatability (lower CoR), the precision of ETDRS VA was similar to that of PR CS. The AULCSF provides highest FRP despite intermediate CoR, due to small step-sizes and low variability relative to its range. These features may be useful to detect visual changes in clinical trials and clinical practice.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:


fraction of subjects with FRP > x
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FRP(AULCSF)= 0.844
FRP(PR CS)= 0.721
FRP(ETDRS VA)=0.718
AULCSF
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PR CS
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FRACTIONAL RANK PRECISION

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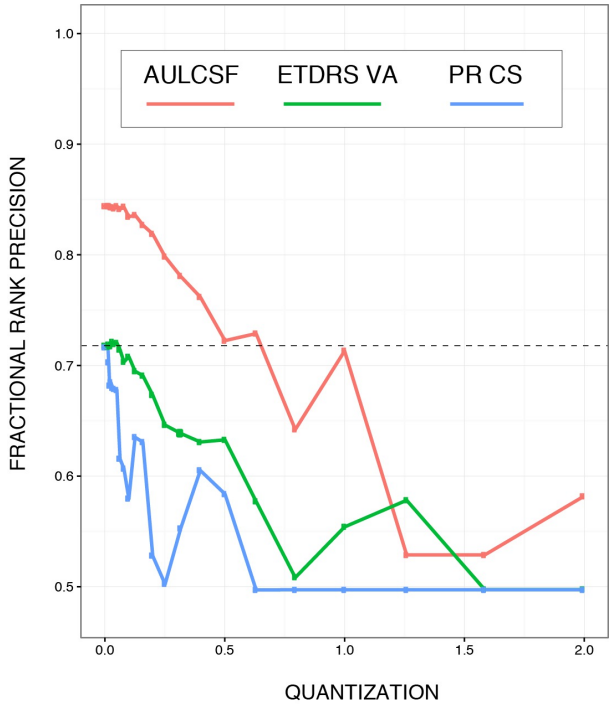
AULCSF
ETDRS VA
PR CS
FRACTIONAL RANK PRECISION
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1.5
2.0
QUANTIZATION

Predicting the Contrast Sensitivity Function in Different Luminance Conditions

View Session Detail | Print Abstract

Posterboard #: B0682

Abstract Number: 4221 - B0682

Author Block: *Fang Hou[1] , Luis A. Lesmes[2] , Woojae Kim[3] , Hairong Gu[4] , Mark Pitt[4] , Jay Myung[4] , Zhong-Lin Lu[4]*
[1] Ophthalmology and Optometry College, Wenzhou Medical Univerisity, Wenzhou, China; [2] Adaptive Sensory Technology, Inc, Boston, Massachusetts, United States; [3] Department of Psychology, Howard University, Columbus, Ohio, United States; [4] Psychology Department, The Ohio State University, Columbus, Ohio, United States

Disclosure Block: Fang Hou, None; Luis A. Lesmes, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code E (Employment)), Adaptive Sensory Technology (Code P (Patent)); Woojae Kim, None; Hairong Gu, None; Mark Pitt, None; Jay Myung, None; Zhong-Lin Lu, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent))

Purpose: The contrast sensitivity function (CSF) provides a comprehensive assessment of spatial vision in both normal and clinical populations. CSF change in low luminance conditions is especially informative for aging vision as well as the diagnosis of AMD (Sloane, Owsley, & Alvarez, 1988; Liu, Wang, & Bedell, 2014). One important question is whether the shapes of CSF measured in different luminance conditions are the same. An affirmative answer would enable us to use the CSF in the standard test condition to predict human performance in a wide range of luminance conditions.

Methods:CSFs of 112 college students with normal or corrected-to-normal vision were measured using the quick CSF procedure (Lesmes, et al, 2010; Hou, et al 2015) in three luminance conditions (2.65, 20.2 and 95.4 cd/m^2). The detailed experimental procedure is described in Hou et al, 2016. CSF is modeled by a truncated log parabola with four parameters: peak gain, peak frequency, bandwidth, and truncation level (Watson & Ahumada, 2005).

Results: Using a maximum likelihood procedure, we found that (1) For 89.3% of the observers, the shape of the CSF, determined by its bandwidth and truncation level, was invariant across luminance conditions, although the peak gain and peak spatial frequency varied across conditions; and (2) the shape of the CSF significantly varied across observers ($p < 0.001$). Further examination of the fits showed that the peak gain, peak spatial frequency and log luminance fell on a straight line in the three-dimensional space. Using the average slope of the straight line from 112 observers, we were able to accurately predict the CSF in 2.65 and 20.2 cd/m^2 with the CSF measured in 95.4 cd/m^2 for each individual observer, with mean $r = 0.98$.

Conclusions: The results suggest that the shape of the CSF is invariant under different light conditions, and we can predict CSF in a range of luminance conditions based on the CSF measured in the standard luminance condition.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.: Our results suggest that the shape of the CSF is invariant under different light conditions, and we can predict CSF in a range of luminance conditions based on the CSF measured in the standard luminance condition.

Computer Adaptive Contrast Sensitivity Testing in Macula-involving Retinal Detachment and Central Serous Retinopathy

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Posterboard #: B0670

Abstract Number: 5934 - B0670

Author Block: *Merina Thomas[1] , Gina Yu[1] , Katherine A. Joltikov[1] , Vinicius M. de Castro[1] , David N. Zacks[1]*
[1] Kellogg Eye Center, University of Michigan, Ann Arbor, Michigan, United States

Disclosure Block: Merina Thomas, None; Gina Yu, None; Katherine A. Joltikov, None; Vinicius M. de Castro, None; David N. Zacks, None

Purpose: To evaluate the Sentio Platform's (Adaptive Sensory Technology, Boston) suitability for clinical application of computer-adaptive contrast sensitivity function (CSF) assessment compared to traditional letter acuity in patients with macula-involving retinal detachment (RD) and central serous retinopathy (CSR).

Methods: Following approval by the University of Michigan School of Medicine's Institutional Review Board, all eligible participants had the following criteria: age 18 years or older; and 1 study eye with macula-involving retinal detachment or central serous retinopathy. Best corrected Snellen and ETDRS (Early Treatment Diabetic Retinopathy Study) visual acuities were obtained from consented participants. Participants also completed an in-office CSF test.

Results: The mean age of all participants was 58 years (range 47 to 73). 3 participants had macula-involving RD and 3 participants had CSR. Mean visual acuity in macula-involving RD and CSR eyes, respectively, was logMAR 0.41 (20/50) and logMAR 0.22 (20/32). Mean visual acuity in control eyes was 0.03 (20/20). In macula-involving RD and CSR eyes, mean CSF area under the curve (AUC), a measure of all letters seen across all contrast levels, respectively was 0.67 and 1.16. Mean CSF AUC in control eyes was 1.39. In a macula-involving RD eye in which the logMAR was -0.125 (20/16), the CSF AUC was 1.37; in control eyes in which the logMAR was 0 or less (20/20 or better), the CSF AUC was 1.47. Macula-involving RD eyes with poor visual acuity, logMAR 0.875 (20/125) and logMAR 0.477 (20/50-20/63), had CSF AUC of 0.15 and 0.50.

Conclusions: These data suggest that the CSF assessment may detect differences in vision in patients with macula-involving retinal detachment and central serous retinopathy that may not be detectable with traditional visual acuity testing. In a macula-involving RD eye with visual acuity of 20/15, the CSF AUC was lower than the average CSF AUC of control eyes with visual acuity of 20/20 or better. Also, eyes with a poor visual acuity had a lower CSF AUC. Further studies and longitudinal follow-up would be needed to determine if this device has a role in vision assessment of patients with macula involving disease processes.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.: Visual acuity is the standard measurement of visual function in retinal diseases. However, in retinal diseases that involve pathology of the macula, the primary function of which is central high-resolution visual acuity, patients can have relatively good letter visual acuity yet continue to complain of poor vision. Contrast sensitivity has been shown to be an alternative method to assess visual function in patients with retinal pathology, including rhegmatogenous retinal detachment. Our data suggest that the contrast sensitivity function testing using the Sentio Platform may detect differences in vision in patients with macula-involving retinal detachment and central serous retinopathy that may not be detectable with traditional visual acuity testing. Further studies and longitudinal follow-up would be needed to determine if this device has a role in vision assessment of patients with macula involving disease processes.

Longevity of Visual Improvements following Transcorneal Electrical Stimulation (TES) and Efficacy of Retreatment in Retinitis Pigmentosa subjects

View Session Detail | Print Abstract

Posterboard #: B0361

Abstract Number: 3228 - B0361

Author Block: *Rachel M. Salveson[1] , Ava K. Bittner[1] , Kenneth R. Seger[1]*
[1] Nova Southeastern University, Davie, Florida, United States

Disclosure Block: Rachel M. Salveson, None; Ava K. Bittner, Adaptive Sensory Technology (Code F (Financial Support)); Kenneth R. Seger, None

Purpose:A previous small scale randomized controlled trial conducted by our group found that 57% of retinitis pigmentosa (RP) subjects who received 6 weekly sessions of Transcorneal Electrical Stimulation (TES) developed significant improvements in visual acuity (VA) and/or quick contrast sensitivity function (qCSF) within a month of completing this short course of therapy. Our next goals were to longitudinally monitor these participants for declining visual function due to natural RP progression without TES to determine the duration of these responses and administer retreatments.

Methods: Following significantly improved VA and/or qCSF after an initial course of 6 weekly 30-minute TES sessions using DTL electrodes and the microcurrent setting on a Trio Stim unit (Mettler Electronics Corp), 3 RP subjects completed follow-up ETDRS VA and qCSF tests over 18-22 months and received a retreatment course of 6 weekly TES sessions when measurable decreases in VA and/or CS occurred.

Results:A 44 y/o female had 1.52 logMAR VA in the worse eye at baseline, which improved to 0.52 logMAR following the initial course of TES, but 10 months later her VA had diminished to 1.22 logMAR, at which time she was retreated and regained VA of 0.62 logMAR at 2 months post-retreatment. Follow-up visits at 6 and 9 months post-retreatment revealed a slight decline to 0.78-0.80 logMAR, then VA improved again to 0.50 logMAR a month after receiving a 2nd course of retreatment. A 47 y/o male had baseline 1.62 logMAR VA and 0.20 logCS at 1.5 cpd in the worse eye, which improved to 1.20 logMAR and 0.46 logCS a month after the initial course of TES; then 11 months later his VA was relatively stable at 1.24 logMAR, but qCSF declined back to baseline (0.22 logCS). Then 14 months after initial TES, VA declined to 1.40 logMAR, at which time he was retreated and improved to 1.32 logMAR and 0.66 logCS at one-month post-retreatment. A 34 y/o female improved binocularly from 1.12 to 1.00 logMAR VA and 0.33 to 0.65 logCS at 1.5 cpd after initial TES, then after slight declines every 3-4 months, she received 3 retreatment courses, which maintained her VA and CS improvements over 18 months.

Conclusions: Following encouraging improvements in VA and qCSF after 6 weekly TES sessions that lasted for several months, it appears possible to restore slowly diminishing vision over time by retreating with TES.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

Dark Adaptation Testing in Retinitis Pigmentosa Patients using the AdaptDx

View Session Detail | Print Abstract

Posterboard #: B0378

Abstract Number: 3245 - B0378

Author Block: *Tracey Topacio[1] , Ava K. Bittner[2]*
[1] College of Osteopathic Medicine, Nova Southeastern University, Davie, Florida, United States; [2] Nova Southeastern University, Davie, Florida, United States

Disclosure Block: Tracey Topacio, None; Ava K. Bittner, Adaptive Sensory Technology (Code F (Financial Support))

Purpose: We report our experience with testing RP patients who have a wide range of vision loss using an instrument that has received FDA 510(k) clearance for measurement of dark-adaptation function, the AdaptDx (Maculogix).

Methods: The AdaptDx was used for dark adaptation testing at 5 degrees from fixation using a 76% initial bleach to assess the most sensitive location (i.e., temporal, nasal, inferior or superior) determined by photopic Humphrey 10-2 static perimetry in 23 RP subjects. Testing was stopped after 5-6 minutes if there was no evidence of dark adaptation (i.e., consistent cone-mediated sensitivity only). Testing was completed twice at two visits within a month for 16 of the subjects. At the same visits, subjects completed the following central visual function tests with and without a NoIR U23 4% transmission filter to simulate low luminance: ETDRS visual acuity (VA), Pelli-Robson contrast sensitivity (CS), and quick contrast sensitivity function (qCSF).

Results: Mean VA across subjects was 0.45 logMAR (SD 0.46; range -0.07 to 1.56). About a quarter to a fifth of the subjects (n=5; 22%) had a measurable rod intercept at 3 log units. Two subjects had a cone plateau at 2 log units and the majority (n=16; 70%) had only a minimal cone response <1 log unit. The test-retest 95% coefficient of repeatability was 0.5 log units for mean sensitivity across subjects with cone-only AdaptDx responses (i.e., no measurable rod intercept). A Bland-Altman graph analysis revealed there was no tendency across subjects with cone-only AdaptDx responses to perform better at either the first or second visit. Reduced mean sensitivity for cone-only AdaptDx responses was significantly associated with reduced central vision with the 4% transmission filter: VA (-0.76; 95%CI:-1.29,-0.23; p=0.005), CS (0.74; 95%CI:0.35,1.12; p<0.001) and qCSF (0.97; 95%CI: 0.51,1.42; p<0.001). Subjects who had >0.2 logMAR reduction in VA with the 4% filter compared to without the filter had significantly reduced AdaptDx cone sensitivity on average (-0.65; 95%CI:-1.12,-0.18; p=0.007).

Conclusions: The AdaptDx may be helpful to characterize RP patients who have rod versus cone-mediated dark adaptation at perifoveal locations and monitor for longitudinal changes.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

Prediction of contrast sensitivity in the presence of glare

View Session Detail | Print Abstract

Posterboard #: B0684

Abstract Number: 4223 - B0684

Author Block: *Marrie Van der Mooren[1] , Robert Rosen[1] , Luuk Franssen[1] , Linda Lundstrom[2] , Patricia A. Piers[1]*
[1] Research & Development, AMO Groningen BV, Groningen, Netherlands; [2] Biomedical & X-ray Physics, KTH Royal Institute of Technology, 10691 Stockholm, Sweden

Disclosure Block: Marrie Van der Mooren, Abbott Medical Optics (Code E (Employment)); Robert Rosen, Abbott Medical Optics (Code E (Employment)); Luuk Franssen, Abbott Medical Optics (Code E (Employment)); Linda Lundstrom, None; Patricia A. Piers, Abbott Medical Optics (Code E (Employment))

Purpose: The objective of this study is to introduce a model which uses the measured contrast sensitivity function (CSF) without a glare source to predict the CSF in the presence of a glare source.

Methods: The CSF was measured in 100 trials with the quick CSF method at three different mean luminance levels (48, 42 and 33.6 cd/m^2) with and without a glare source on five healthy subjects. The different luminance levels were obtained using calibrated photographic filters. The position of the glare source was 2.5 degrees away from the contrast stimuli and the illuminance of the glare source was 12 lux at pupil of the eye. The area under the logarithm of the CSF curve (AULCSF) was used as outcome parameter. Furthermore, the stray light parameter at an angle of 2.5 degrees was measured. The reduction of CSF with a glare source was predicted from the measured CSF without a glare source through the calculation of a factor defined as the mean luminance of the contrast test divided by the sum of the mean luminance of the contrast test and the veiling luminance induced by the glare source. The veiling luminance was determined by the stray light parameter of the subjects at 2.5 degrees, the strength of the glare source and the angular position of the glare source with respect to the contrast test. The predicted AULCSF with glare source was compared to the measured AULCSF with a glare source. The found difference in AULCSF was compared to the precision of the CSF test (0.1 AULCSF units) to assess the quality of the prediction.

Results: The average measured stray light parameter of the subjects was 1.1 log(s). The measured AULCSF ranged from 2.0 to 2.4 and from 1.8 to 2.1 AULCSF units for the measurements without and with a glare source, respectively. The differences between the model prediction and measured AULCSF for the luminance levels 48, 42 and 33.6 cd/m^2 were 0.05, 0.05 and 0.03 AULCSF units respectively. The prediction error was within the precision of an individual contrast sensitivity measurement using 100 trials.

Conclusions: The described prediction model is capable of estimating the CSF with glare based on the measured contrast sensitivity function without glare for the given subset of five healthy subjects.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

Bayesian adaptive assessment of reading performance: the quick Reading method

View Session Detail | Print Abstract

Posterboard #: B0698

Abstract Number: 4237 - B0698

Author Block: *Zhong-Lin Lu[1] , Fang Hou[3] , Luis A. Lesmes[2] , Peter J. Bex[4] , Deyue Yu[5]*
[1] Psychology, The Ohio State University, Columbus, Ohio, United States; [2] Adaptive Sensory Technology, Inc, Washington, District of Columbia, United States; [3] School of Ophthalmology & Optometry, Wenzhou Medical University, Wenzhou, Zhejiang, China; [4] Psychology, Northeastern University, Boston, Massachusetts, United States; [5] College of Optometry, The Ohio State University, Columbus, Ohio, United States

Disclosure Block: Zhong-Lin Lu, Adaptive Sensory Technology, Inc (Code I (Personal Financial Interest)), Adaptive Sensory Technology, Inc (Code P (Patent)); Fang Hou, US Provisional Patent 62/378,334 (Code P (Patent)); Luis A. Lesmes, Adaptive Sensory Technology, Inc (Code I (Personal Financial Interest)), Adaptive Sensory Technology, Inc (Code E (Employment)), Adaptive Sensory Technology, Inc (Code P (Patent)); Peter J. Bex, Adaptive Sensory Technology, Inc (Code I (Personal Financial Interest)), Adaptive Sensory Technology, Inc (Code P (Patent)); Deyue Yu, US Provisional Patent 62/378,334 (Code P (Patent))

Purpose: Reading is a fundamental skill and the reading performance is a key endpoint for quantifying normal or abnormal development and aging. Successful reading performance requires ophthalmic, cognitive and oculomotor proficiency. The deficit or pathology in any of these functions can lead to a deficit in reading performance (Legge *et al* 1985). Despite its importance for clinical and developmental assessment, existing reading tests are time consuming and difficult to administer. In this study, we propose a novel method, the quick Reading method, for automated measurement of reading speed at multiple letter sizes based on Bayesian adaptive testing (Lesmes, et al., 2010).

Methods:A three-parameter exponential function is used to describe the reading speed vs print size function. The quick Reading method selects the optimal test stimulus (print size and presentation duration) by maximizing the expected information gain in each trial and updates the posterior distribution of the parameters of the reading function. The precision and bias of the estimated reading function of a simulated observer obtained using quick Reading were evaluated. Reading functions measured by the conventional (Psi method, Kontzevich & Tyler, 1999) and quick Reading methods in a true/false paradigm (Crossland *et al,* 2008) were compared in an experiment.

Results: The precision of quick Reading method was 0.26, 0.17 and 0.06 log10 unit after 10, 20 and 100 trials, respectively. The bias of the quick Reading method was 0.21, 0.17 and 0.10 log10 unit after 10, 20 and 100 trials, respectively. The estimated reading functions obtained with the conventional and quick Reading methods did not differ significantly (paired t-test, $p = 0.184$); There were highly correlated ($r = 0.969$, $p = 0.001$). The precision of the reading function obtained with 60 quick Reading trials was comparable to that of conventional method with 240 trials.

Conclusions: The quick Reading method can be used to precisely and efficiently assess reading performance, with great promise in clinical applications.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.: We proposed a novel method which can access the reading performance precisely and efficiently.

The quick reading method: its efficiency and accuracy in assessing reading performance in the periphery

View Session Detail | Print Abstract

Posterboard #: B0411

Abstract Number: 3278 - B0411

Author Block: *Timothy G. Shepard[1] , Fang Hou[2] , Peter J. Bex[3] , Luis A. Lesmes[4] , Zhong-Lin Lu[5] , Deyue Yu[1]*
[1] College of Optometry, Ohio State University, Columbus, Ohio, United States; [2] Wenzhou Medical University, Wenzhou, Zhejiang, China; [3] Psychology, Northeastern University, West Newton, Massachusetts, United States; [4] Adaptive Sensory Technology, San Diego, California, United States; [5] Psychology, Ohio State University, Columbus, Ohio, United States

Disclosure Block: Timothy G. Shepard, None; Fang Hou, US Provisional Patent 62/378,334 (Code P (Patent)); Peter J. Bex, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent)); Luis A. Lesmes, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent)), Adaptive Sensory Technology (Code E (Employment)); Zhong-Lin Lu, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent)); Deyue Yu, US Provisional Patent 62/378,334 (Code P (Patent))

Purpose: Patients with central vision loss have to rely on their peripheral vision for reading. Accurate assessment of reading performance can help prescribe suitable adaptive devices to the patients. In this study, we develop an adaptive method, quick reading (qR), to measure reading speed in the periphery. While the conventional method is adequate, qR utilizes a Bayesian adaptive framework to select optimal stimuli, thus allowing for an efficient assessment of reading speed in the periphery.

Methods: Eight normally-sighted observers participated. We used a rapid serial visual presentation (RSVP) paradigm where words were serially presented at 10° in the lower field. The conventional method involved measuring reading accuracy as a function of exposure duration. Reading speed at a given print size is defined as the duration at which subject's response is 80% correct. The reading speed versus print size function was estimated by measuring reading speed at five print sizes (a total of 180 trials). In the qR procedure, reading speed versus print size was described by an exponential function with three parameters (asymptotic performance level, print size corresponding to a reading speed of 6 wpm, and a decay constant). Following each trial (50 trials total), posterior distributions of the parameters were updated based on subject's response, and a stimulus condition (print size and exposure duration) was selected to provide the maximal expected information gain for the upcoming trial.

Results: Reading curves (reading speed vs. print size) estimated using the two methods were comparable across observers (area under curve: $t(7)=1.87$, $p=0.10$). The conventional data was analyzed using the Bayesian fitting component of qR. A paired-samples t-test was conducted to compare 68.2% credible intervals between the qR and conventional methods. The qR method was more precise (i.e. smaller credible intervals) than the conventional method when considering only 50 conventional trials ($p=0.0004$) and comparable when 180 conventional trials were included ($p=0.11$).

Conclusions: The current investigation demonstrates that the qR method can adequately measure reading function in the periphery but with higher precision than the conventional method.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

Do oculomotor adaptations to a volume scotoma provide functional benefits for binocular vision?

View Session Detail | Print Abstract

Posterboard #: B0647

Abstract Number: 4695 - B0647

Author Block: *Concetta F. Alberti*[1] *, Peter Bex*[1]
[1] Psychology, Northeastern University, Boston, Massachusetts, United States

Disclosure Block: Concetta F. Alberti, None; Peter Bex, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent))

Purpose: Binocular eye movements can adjust the projection of a retinal volume scotoma (Arditi, 1988) and modify the retinal disparity of targets in depth. We recently showed (Alberti et al, ARVO 2015) that observers with gaze-contingent simulated independent scotomas make binocular eye movements that move the location of the volume scotoma. We assessed whether such adaptations improve binocular contrast sensitivity in the peripheral visual field.

Methods: The contrast sensitivity function was measured with a 26AFC task in which normally-sighted observers (N=6) identified bandpass filtered letters whose spatial frequency and contrast were varied with modified quickCSF algorithm (Lesmes et al, 2010). The letters were positioned 2° in the lower visual field and, in randomly interleaved trials, were either in corresponding retinal locations or displaced horizontally by ±0.25 letter widths to create near or far visual disparity. The gaze contingent scotoma in each eye was a Gaussian windowed (σ=0.5° OS and 1° OD) patch of pink noise, centered on the fovea. Dichoptic presentation of the stimuli was controlled with nVidia 3D glasses synched to a low-latency 144Hz display and eye tracking was measured at 1000Hz with an Eyelink II.

Results: The area under the logCSF (AULCSF) was lower for positive or negative disparity stimuli than for stimuli at zero disparity (mean 1.55 vs 1.73, $p<0.001$), as was peak contrast sensitivity (mean 1.43 vs 1.61, $p<0.001$). CSF acuity (the highest spatial frequency letter identifiable at full contrast) and other parameters of the CSF did not significantly vary with disparity.

Conclusions: In the peripheral visual field, binocular contrast summation requires spatially aligned stimuli and does not occur for disparity-defined targets. Thus oculomotor adaptations that shift the location of a volume scotoma may assist fixation control, but are not associated with functional benefits in contrast sensitivity.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.:

The quick Change Detection method: Bayesian adaptive assessment of the time course of perceptual sensitivity change

View Session Detail | Print Abstract

Abstract Number: 5633

Author Block: *Yukai Zhao[1] , Luis A. Lesmes[2] , Zhong-Lin Lu[1]*
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Disclosure Block: Yukai Zhao, None; Luis A. Lesmes, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent)), Adaptive Sensory Technology (Code E (Employment)); Zhong-Lin Lu, Adaptive Sensory Technology (Code I (Personal Financial Interest)), Adaptive Sensory Technology (Code P (Patent))

Purpose: Perceptual sensitivity is usually estimated over some test-time intervals, which results in imprecise and biased estimates when it changes over time. A novel procedure, the quick Change Detection (qCD) method, is developed to accurately, precisely, and efficiently quantify the full time course of perceptual sensitivity change, and demonstrated in dark adaptation.

Methods: Based on Bayesian adaptive testing (Lesmes, et al, 2010), the qCD method selects the optimal stimulus, and updates, trial by trial, a joint probability distribution of the parameters that quantify both perceptual sensitivity and its change over time. In a dark adaptation experiment, the time course of visual sensitivity change was measured with qCD and quick Forced-Choice (qFC, Lesmes, et al, 2014) in separate sessions. Each session started with a 120-second exposure to high luminance (150 cd/m^2) and followed by measurement of visual sensitivity during 600 seconds of dark adaption (0.0 cd/m^2). Subjects identified the location of a 1.7° diameter luminance disk that randomly occurred in one of eight locations on an imaginary circle at 5° eccentricity. With qCD, the dark adaptation curve was estimated and updated in every trial. With qFC, threshold was estimated every 10 seconds. Simulations were performed to evaluate the two methods. Accuracy was quantified as average absolute bias, and precision as the standard deviation (STD) of repeated tests and half width of the 68.2% credible interval (HWCI) from a single test.

Results: Simulations showed that the bias, the STD and 68.2% HWCI of the dark adaptation curve fell below 0.1 and 0.02 (log10 unit) after 100 and 200 seconds of qCD test, respectively. Two and four repeated qFC tests, each taking 720 seconds, were necessary to achieve similar accuracy and precision. Furthermore, a 0.02 log10 bias persisted even after 10 repeated qFC tests. The experiment showed that the estimated dark adaptation curve obtained from a single qCD test was highly consistent with the average of four repeated qFC tests.

Conclusions: The qCD method can accurately, precisely, and efficiently quantify the time course of perceptual sensitivity change, as demonstrated in dark adaptation. This method can be extended and applied to perceptual learning, where measurement of the full time course of sensitivity change is critical but cannot be repeated.

Layman Abstract (optional): Provide a 50-200 word description of your work that non-scientists can understand. Describe the big picture and the implications of your findings, not the study itself and the associated details.: