Faculty Profile: Shaban Demirel
Recent Advances in Automated Perimetry
Equipment Report
School Screening Program at Indiana University School of Optometry and the State
In This Issue

The faculty member profiled in this issue is Shaban Demirel, who is a relatively recent addition to our faculty. His featured review covers recent advances in automated perimetry, an area in which he has actively worked. Along those same lines, Vic Malinovsky talks about equipment he uses regularly in the Ocular Disease Clinic: the Heidelberg Retina Tomograph and new visual fields instruments.

The school screening program at Indiana University School of Optometry has a long history and continues to screen thousands of children annually. The school screening program is discussed by Don Lyon and Richard Meetz. We also present a review of an interesting article that found that some abnormal binocular vision findings are less common among preschool children than in school-age children. As in past issues, we also have some news items from the School of Optometry.

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Cover: A glaucomatous optic nerve imaged with the Heidelberg Retina Tomograph (HRT) on the left, and the results from SWAP examination of an ocular hypertensive who had normal standard Humphrey visual fields on the right.

Please contact us with your comments or suggestions by calling 812-855-0481 or emailing the editor at dgoss@indiana.edu or the production manager at jocombs@indiana.edu
Profile: Shaban Demirel
by Arthur Bradley

Shaban Demirel was born in Kent, England, and moved to Australia at the age of six when his family emigrated “down under.” Twenty-one years of living in Australia fostered a love of the outdoors and sports, and most of his hobbies (hiking, cycling, squash) revolve around these pursuits. Shaban was active in athletics as a youngster but this gave way to academics in the later high school years.

His first contact with optometry was at the age of five when, at a school screening, he was found to have reduced visual acuity in one eye. He was treated for amblyopia at several stages during his childhood and was consequently introduced to eye and vision care at an early age. Having thus been exposed to the field of optometry, he considered it an option when it came time to choose a career.

Dr. Demirel started his optometric career in Melbourne, Australia, where he obtained his B.Sc.Optom. degree in 1989. He remained at the University of Melbourne where he entered the Ph.D. program in Visual Science. During this time, he became an experienced laboratory teacher, running many of the physiological optics laboratories. He also acted as a clinical instructor for the final year optometry students, gave topical lectures in the ocular disease program, and presented a number of continuing education programs. He completed his Ph.D. research on the always challenging topic of perimetry in Fall, 1995.

Dr. Demirel continued his research program in perimetry and glaucoma while undertaking two years of post-doctoral training at the University of California at Davis. There he worked with one of the world’s top perimetry research groups headed by Professor Chris Johnson. He joined the Indiana University School of Optometry faculty in the Fall of 1997. While at Indiana University, Dr. Demirel has been lecturing in ocular physiology, ocular disease, and clinical methods, while developing a research program to study the progression and early detection of glaucoma and other diseases that affect retinal function.
Recent Advances in Automated Perimetry
by Shaban Demirel, B.Sc.Optom, Ph.D.

In the last decade or so, automated threshold perimetry has become the "gold standard" in visual field assessment. Nowhere is this more evident than in the process of making a diagnosis of glaucoma, or monitoring a patient for evidence of progression once a definitive diagnosis is made.

It has been accepted for quite some time that automated perimetry can detect functional damage earlier in the glaucomatous process than manual perimetric methods such as Goldmann bowl or tangent screen. This clinical impression has only recently been backed up by prospective, longitudinal investigation of ocular hypertensives and those at risk for the development of glaucoma. Automated perimetry has risen to the level of "standard of care" in functional assessment of glaucoma suspects; however newer perimetric methods arguably provide the earliest evidence of glaucoma available to the clinician. In many situations, functional abnormality will be evident prior to confirmed changes at the optic nerve head or retinal nerve fiber layer.

Recent advances in automated perimetry have given clinicians the ability to diagnose glaucoma at an earlier stage than ever before. The quest for a perimetry test that can detect loss at an early stage has been ongoing since automated perimeters came onto the market in the 1970's. This "Holy Grail" in automated perimetry has yet to be developed. In fact, it is becoming increasingly obvious that a single test can not be developed that will be sensitive enough to detect the earliest signs of disease and still have sufficient dynamic range to follow patients whose disease has progressed to a severe stage. We now have available to us tests with very good sensitivity for early disease detection and this aspect of automated perimetry has probably moved forward as far as it is likely.

Other recent advances have occurred along themes that have been largely ignored by many perimetry researchers. These efforts have produced instruments and algorithms that will perform a threshold examination in less than half the time that it would have taken four or five years ago. This push for rapid visual field assessment now occupies a central position in many perimetry research programs.

Advances in visual field assessment have also yielded very sensitive screening tests that can assess the field status of a patient in substantially less than one minute per eye. It is now a viable option to screen the visual field of every single patient to walk into a practice, with few exceptions, in a controlled, repeatable and very sensitive manner. The cost-benefit ratio for this type of perimetric investigation is definitely moving in the benefit direction, as the real dollar and time costs of visual field screening have fallen precipitously in recent years, particularly with the advent of the Frequency Doubling Technology (FDT) device.

Advances in automated perimetry have come about through the utilization of novel stimulus modalities and through modification of screening and thresholding algorithms. An algorithm is a set of decision rules that guide the process of estimating a patients threshold during a threshold test or determines the screening intensities to use during a screening test.

Some years ago, a prominent perimetry researcher suggested that instead of concentrating on making more and more sensitive tests, perhaps we should encourage our colleagues to use the tools they already have and make better use of information they currently have. Consequently, a brief summary of some important concepts in visual field assessment and automated perimetry as it is practiced today, must precede any discussion of recent developments. Some recent advances will be presented after this short refresher.

What do all the numbers mean and where should I be looking?
Many practitioners already have access to automated perimeters and use them on a daily basis. One of the most common complaints from these practitioners is that they feel overwhelmed by the amount of information that spills forth from their instruments at the completion of a test. To have a chance of making sense of this data, it is essential that the practitioner know where to look for different types of information.

Generally, data are grouped according to a few common themes in visual field assessment. In much of the discussion to follow, information particular to
the Humphrey Visual Field Analyzer will be described (since it is the most widely used device in clinical practice in the United States). Since many perimeters use similar mathematical “tricks” and themes to extract meaning from the threshold values, this information is often pertinent to devices other than the Humphrey Field Analyzer. Oftentimes similar visual field indices are found with different names on other instruments. They nearly all use the decibel scale to describe the raw threshold values however.

The decibel values that most automated perimeters report are straightforward. For the purposes of this discussion, they are simply a representation of sensitivity - higher values mean dimmer lights were seen by the patient, suggesting better sensitivity. But how should one interpret them? What does it mean if a 70-year-old patient has threshold values between 21dB and 27dB? None of us can be expected to remember what is normal for all age groups at all the field locations tested by the instruments we use. In an effort to extract some sort of meaning from the threshold numbers, visual field indices and probability scales were developed. Indices are mathematical condensations of the data that are designed to extract clinically relevant information. Some indices are designed to accentuate the overall or average level of damage across the field. Other indices are designed to accentuate localized damage in the field once any widespread damage has been factored out. Yet other indices are designed to alert the clinician to patterns of visual field damage suggestive of glaucoma.

Indices and statistical representations are key to efficient interpretation of visual field information. Once data have been converted into an index based or statistical representation, it becomes comparable across platform, from machine to machine, patient to patient and from clinic to clinic. Visual field indices can be grouped into global and local indices and statistical representations can be made on a global or point-by-point basis.

**Global Indices**

These indices attempt to distill the information contained in the threshold values into a single meaningful number with diagnostic significance. For example, the Mean Deviation index (MD) describes the mean elevation or depression of the patient's field compared to a normal reference field for a patient of similar age. Mean Deviation is affected by widespread or generalized depression, but not as much by localized abnormality unless the scotoma is quite large or deep. As such, it can be thought of as an indicator of the average amount of threshold reduction with no consideration given to where the loss occurs. Unfortunately, small pupils and cataracts can cause widespread reduction in visual field sensitivity. This makes the MD index less useful for distinguishing between optical factors that reduce sensitivity and retinal / optic nerve factors such as glaucoma.

In contrast to the Mean Deviation index, the Pattern Standard Deviation index (PSD) gives an indication of whether the shape of the patient's field is different to the shape of a normal field from someone of similar age. Low PSD values indicate a smooth Hill of Vision (HoV) while high PSD values indicate an irregular HoV. This index was designed to flag localized changes in the visual field such as paracentral scotomata, nasal steps or any type of loss that is not widespread. Widespread reduction of sensitivity, as might be expected when a patient has cataract or a small pupil would not be expected to elevate the PSD index. This distinction becomes very important when trying to extract useful information from Short Wavelength Automated Perimetry (SWAP).

Unfortunately, the PSD index can be “tricked” when a patient makes false positives or false negatives or if they fluctuate in their responses. Imagine a patient who is responding variably during testing. This will tend to produce some visual field locations with low thresholds and others with higher thresholds. This makes the HoV less smooth and can elevate the PSD index. The Corrected Pattern Standard Deviation index (CPSD) attempts to remove this confound by weighting the PSD index by the patient's fluctuation. If the patient is variable, then the CPSD attempts to factor out the effect that patient variability has on the PSD. This makes the CPSD index very important for efficient visual field assessment as it factors out overall changes in sensitivity that may be caused by a small pupil or lens changes and it removes the effect of patient unreliability. Once again, this index is extremely important when trying to assess visual fields measured with SWAP, or when trying to compare visual field results that have been measured with different perimeters.

**Statistical Interpretation**

Global indices like MD, PSD and CPSD condense the information for the visual field into a single number. This number still needs to be interpreted, as most of us won't remember if a CPSD value of 3.6 is normal, moderately high or very high. Most indices can be interpreted in terms of the statistical likelihood that a normal patient would produce a similar value. This is the real crux of efficient visual field assessment. Most of us don't perform a visual field examination because
we want to know what a patient’s threshold is - we want to know if the visual field is normal or not. Statistical packages interpret the threshold values and indices for us. Ideally, statistical values are machine independent, they allow comparison between different instruments and between the same instrument running alternative threshold algorithms. Statistical packages allow us to compare between machines, so long as they use the same type of stimulus, and should allow us to compare different algorithms, such as full threshold with the new Swedish Interactive Threshold Algorithm (SITA).

**Probability of Abnormality**
Statistical probability values are not only generated for the global indices (MD, PSD and CPSD) they can also be calculated on a pointwise basis. A pointwise probability value indicates the likelihood that a given threshold measured at a particular location is within the expected range of normal values. Probability of abnormality plots place different tests on a level playing field. If two instruments are assessing the same function, they should return the same probability plots. For example, the Humphrey field analyzer and the Octopus 123 perimeter both use a small light on a white background. Theoretically, they should both be testing the same type of visual function - your patients ability to detect small spots of light in their periphery. We would expect the probability plots generated from these two instruments to be similar, even if the decibel values were quite different. Decibel values are very machine specific, they are a relative sensitivity scale that cannot be compared from machine to machine. If, on the other hand, two instruments are not testing the same function (e.g. standard white-on-white perimetry and SWAP), then the probability of abnormality might not be identical, or even similar. Because the two techniques assess different aspects of visual function, it is quite possible that one test will suggest abnormality while the other test suggests that all values are within normal limits. This is certainly the case when ocular hypertensives and those at risk for developing glaucoma are tested with SWAP and with standard white-on-white perimetry.

**The Glaucoma Hemifield Test**
The Glaucoma Hemifield Test (GHT) uses five zones in the upper hemifield and five mirror-image zones in the lower hemifield. The threshold values are analyzed according to probability of abnormality values. Up-down asymmetry between these zones is then sought. Based on the up-down differences and the overall level of sensitivity, five possible messages can appear on the printout to alert the clinician to the likelihood that the field was measured from a person with glaucoma - more particularly, whether the field shows some of the signs that we have come to expect in a glaucomatous field.

Armed with an understanding of what different visual field indices mean and where to look for pertinent information on a visual field printout, it is now possible to exploit the instruments that are currently available and often used in practices. But what can the clinician expect to be using in the years to come? Some of the recent advances in automated perimetry are already making large inroads into routine clinical practice.

**New Perimetric Methods**
Short Wavelength Automated Perimetry (SWAP) SWAP uses a two-color increment threshold technique to assess the functional status of the short wavelength sensitive (SWS) color vision mechanism. This 'mechanism' relies upon the activity of short wavelength sensitive (blue) cones, a special class of bipolar cell and a special class of ganglion cell (the small-field bistratified ganglion cell). During standard automated perimetry, a small (Goldmann size III, 0.5° diameter) white stimulus is usually presented against a medium intensity white background. Three modifications need to be made to this configuration to ensure that stimuli are detected by the SWS mechanism. The stimulus needs to be short wavelength (blue), it needs to be increased in area, and finally it needs to be presented upon a bright yellow or white background. Contrary to intuition, blue stimuli presented on a dim background are actually processed through the red and green cones. The bright yellow background used in SWAP ensures that the stimulus is detected via the short wavelength sensitive cones. Although a variety of stimulus/background configurations have been employed in different laboratories, recent collaboration has attempted to standardize the parameters of SWAP testing. The parameters determined to give optimal performance and maximum dynamic range were a Goldmann size V (1.75° diameter) blue target (440nm peak) displayed on a 100cd/m2 yellow background. This configuration was adopted by Humphrey for use in the Humphrey Visual Field Analyzer II. The stimulus color is matched to the peak sensitivity of the short wavelength sensitive cones and the bright yellow background reduces the sensitivities of medium- and long-wavelength sensitive cones so that the SWS mechanism is isolated. The ganglion cells that process information from the SWS cones comprise only a small fraction of all retinal ganglion cells, no more than 5% - 10% depending on eccentricity.
Some researchers believe that the reason SWAP is able to detect disease at an early stage is the fact that there are so few ganglion cells able to process the stimulus - as soon as any start to die, functional abnormality becomes evident.

SWAP is performed in much the same way as standard automated perimetry. Manufacturers that have incorporated SWAP into their perimeters offer this modality in the same device. The instructions given to the patient are very similar, i.e., "push the button when you see a light". However, a practice session must be performed, especially by those patients who have had experience with standard automated perimetry. This is due to the very different perceptual quality of the stimulus. The SWAP stimulus often appears blurry and generally tends to be less salient. Anyone who is going to be running SWAP should experience the test as a subject before attempting to instruct others on what to expect.

SWAP has repeatedly been shown to detect abnormality in patients with pre-glaucomatous risk factors, in patients with optic neuritis and in diabetics when standard visual fields are still within normal limits.\textsuperscript{3-5} A number of longitudinal studies have shown that abnormality detected with SWAP precedes standard field loss by three or more years. SWAP also usually reveals a larger area of damage in glaucoma patients than is evident in their standard field results. The additional areas of SWAP damage will often herald extension of standard visual field damage into areas abnormal with SWAP.\textsuperscript{6}

Most investigations of SWAP have been devoted to glaucoma but SWAP has also been used to investigate patients with non-glaucomatous, neurological causes of vision loss. Generally, patients in these studies showed loss that was more extensive with SWAP than with standard field assessment.\textsuperscript{7, 8} Abnormal SWAP results have also been reported in diabetics who have no evidence of retinopathy, particularly if they have blood labs suggestive of poor glucose control. Longitudinal follow up studies in diabetics have not yet been performed, so it remains to be seen if retinal areas that show poor sensitivity with SWAP eventually go on to develop retinopathy earlier than other areas. Investigation of diabetic patients with macular edema has shown that SWAP defects can be present even when standard fields are within normal limits. Those patients that have abnormal standard fields will usually show more severe abnormality with SWAP.\textsuperscript{5}

It is well accepted that SWAP results display more variability than standard fields. In spite of this increased variability, SWAP still provides earlier detection of glaucomatous damage than standard perimetry in the vast majority of patients. Another interesting finding is that once a patient converts to abnormality with SWAP, they have less likelihood of producing a normal SWAP result at a subsequent examination.\textsuperscript{9} Patients who produce an abnormal standard field will often produce a normal standard field some time later. This is surprising since the increased variability seen in SWAP would normally suggest that there should be a greater chance of misclassification from one test to the next. We have yet to interpret the significance of this finding but it may be borne out by a better understanding of the responses of different classes or retinal ganglion cells to pressure lowering therapies.

One of the disadvantages of SWAP is the decreased transmission of short wavelength light as the eye ages. In an elderly patient with glaucoma, it is sometimes difficult to tell whether sensitivity reduction in SWAP is due to progressive glaucoma or increased lens yellowing. There is a redeeming feature, however, SWAP defects in glaucoma patients tend to display nerve fiber bundle patterns and nasal steps and all of the other features of a glaucomatous field. It is possible then, to utilize some of the visual field indices discussed earlier that are designed to highlight local field defects and hemifield asymmetry such as the pattern standard deviation (PSD) and the glaucoma hemifield test (GHT).\textsuperscript{10, 11} When trying to tease apart the effect of neural and lens changes in elderly patients tested with SWAP, it is important to look at the local indicators of loss such as PSD, CPSD, and GHT.

Macular pigmentation has also been shown to affect SWAP results. People with dense macular pigments (xanthophylls, not melanin pigmentation) tend to have lower SWAP sensitivity. Since this pigment is confined to the macular area and it remains largely unchanged over time, it is of minor importance when using SWAP for glaucoma detection. It can complicate the utility of SWAP in the management of diabetic macular disease however unless a hemifield asymmetry approach is used.

Another disadvantage of SWAP currently is the lack of a rapid thresholding algorithm. Most practitioners who use SWAP use it with the Fastpac threshold algorithm. Fastpac is more variable and less precise than the full threshold option and this makes test results even more variable. A fast thresholding option called SITA SWAP is soon to be released (see...
discussion of SITA below), but sources have been suggesting imminent release for some months now. As soon as SITA SWAP becomes available, the increased sensitivity of SWAP will be married to the rapid thresholding capabilities of SITA, making it a much more attractive clinical option.

Frequency Doubling Technology Perimetry (FDT)
The FDT device looks very much like the vision-screening devices often used at license testing stations. It is not a bowl type perimeter, which makes it fairly small, light and portable. Many patients find it less intimidating than the larger bowl-type perimeters. The solid-state nature of the device and the fact that there are no filter wheels or projector arms keep maintenance costs to a minimum.

The FDT unit has a sliding headrest that doubles as a light baffle and incorporates an occlusion mechanism. This removes the need to patch the non-tested eye. In our clinics, however, we have found that some patients will have a problem with this device if they have particularly strong eye dominance. In these patients, we have found that patching the eye not being tested helps somewhat, although we have no sound explanation for why this helps. The first sign that a patient will have this type of problem will be an abnormal screening exam that is not expected given the symptoms and other test finding. This will often revert to a normal screening result if the test is repeated with a conventional patch in place.

There are 16 stimulus location (four in each quadrant) and one macular stimulus in the central pattern. The stimuli are striped, square patches, almost 10° in width, except for the macular test stimulus, which is circular. The stripes are in the form of a low spatial frequency grating, which undergoes counterphase flicker at about 25Hz. This means that dark stripes become light and light stripes become dark about 50 times a second. The appearance is more of a shimmering patch than a flickering striped pattern. Because of the low spatial frequency nature of the stimulus, accurate refraction is unnecessary. Defocus tends to have a more profound effect on the visibility of higher spatial frequencies. Consequently, the manufacturer suggests that it is appropriate to use the patients habitual near correction during testing, whether this is single vision, bifocal, multifocal or nothing at all.

The test is performed in a similar manner to standard perimetry. The patient is told to respond by button press when they see a shimmering light while continuing to hold their gaze on a central fixation point. The contrast of the stimulus is adjusted under the control of a thresholding algorithm and the minimum contrast required for detection of the shimmering pattern is defined as threshold.

Because of the small number of stimulus locations, and an efficient thresholding algorithm, FDT tests take very little time. Threshold tests can be performed in less than five minutes per eye, while screening can take as little as 45 seconds per eye. Short test times make this instrument ideal for pre-screening every patient in a clinical setting. Researchers have recently claimed that they can make the thresholding algorithm even more efficient and threshold test times as low as 2-2.5 minutes per eye have been reported.

Being a relatively new test, there are not many people around with a good "clinical feel" for the results produced by FDT. This will no doubt change, and to some degree already is changing, as more units find their way into clinics and practices.

There is some concern that the small number of relatively large stimuli may result in early, small defects being missed. Current research shows that the FDT has similar sensitivity and specificity to standard perimetric methods when classifying normal and glaucomatous visual fields. In some research efforts, a greater number of smaller stimuli have been used, arranged in a manner similar to the 24-2 pattern on the Humphrey Visual Field Analyzer. This alteration improves the techniques ability to detect small defects but has the undesirable side effect of increasing the test duration. In its current 17-stimulus mode, it still has very good sensitivity and specificity for detecting even early glaucomatous field damage compared to standard Humphrey fields but it may not determine the shape of the defect quite as accurately. Some investigators have examined the criterion that should be used to determine abnormality with FDT. In screening examination, investigators have suggested using two locations at the 5% abnormality level or one location at the 1% abnormality level as the cut off for classifying a test as abnormal.

The most commonly cited theory for FDT’s ability to detect early glaucoma is based in the spatial and temporal nature of the stimulus. It is claimed that low spatial frequency / high temporal frequency information is processed through a select sub-type of retinal ganglion cells. These cells, called Y-type Magno cells, tend to respond best to lower spatial and higher temporal frequencies. Y-type Magno cells, which are ideally suited for detection of the stimulus
used in FDT, comprise only 3-5% of all retinal ganglion cells. It is theorized that if any of these cells are damaged then sensitivity will fall. This theory has not been validated by neurophysiological investigation.

The Swedish Interactive Thresholding Algorithm (SITA)

Development of this algorithm was performed largely in Malmö, Sweden - hence its name. This algorithm uses variable step sizes and “intelligent” decision rules when establishing threshold, resulting in substantial timesavings, whilst retaining the accuracy and precision of the full threshold algorithm. The main thrust of this algorithm is that the most likely estimate of threshold is always displayed in the next stimulus presentation. The likely threshold is computed based on population expectations and the patient’s responses to previously displayed stimuli. This type of algorithm is computationally intensive because the thresholding program is continuously calculating what intensity should be presented next. It took the availability of small, fast processors for this type of testing algorithm to be feasible in an automated perimeter.

SITA comes in two varieties, SITA standard and SITA fast. These options differ in the stopping rules that are applied before a threshold is deemed to have been reached. SITA standard was intended to supercede the full threshold option whereas SITA fast was intended to replace the Fastpac algorithm.

It has been found that thresholds measured with SITA standard are generally 1dB better than when measured with the full threshold algorithm. This has been attributed, by some, to less patient fatigue during the shorter SITA test. Since the dB values are not comparable between full threshold and SITA, it is a mistake to try to evaluate the dB threshold scores generated during SITA examination using a criterion developed for the full threshold test. When migrating patients from full threshold to SITA, it is especially important to examine the visual field indices such as PSD and GHT and the probability maps (especially the pattern deviation probability maps). Since full threshold and SITA both use the same stimulus, they should test the function of the same types of retinal ganglion cells, the probability of abnormality for the two tests should therefore be similar - they won't be exactly the same. This is a very important point - look to the probability values for the most valid mode of comparison.

Not only are the dB values slightly higher, suggesting better sensitivity when using SITA, some investigators have suggested that there is also less variability when SITA is used. This may be due in part to less patient fatigue because of the shorter test time. One advantage of the lower variability is that defects do not need to be as deep before they reach statistical significance.

References:
Equipment Report: *Heidelberg Retina Tomograph and Visual Fields Testing*

By: Victor Malinovsky, O.D.

**HRT**
The Heidelberg Retina Tomograph or HRT (Figure 1) is a safe, non-invasive confocal scanning laser imaging device that can be used to obtain three-dimensional images of the optic nerve head and retina in the posterior segment. The HRT software analyzes height changes or differences on the optic nerve head. It is becoming an essential piece of equipment in diagnosing early glaucoma and monitoring the progression of glaucoma.

![Figure 1. The Heidelberg Retina Tomograph (HRT).](image)

The HRT works by focusing a confocal diode laser beam with mirrors on the retina and the nerve head. It records the focused reflected light of the laser beam at over 65,000 points. This process is very rapid and requires only 1.6 seconds to acquire all of the needed images. It stores 32, two dimensional reflectance patterns and then combines them in a "layer by layer" fashion to make a three dimensional image of the optic nerve head. This makes a topographical map of each patient's nerve head showing both height and depression with an accuracy of 20 microns at each of the points. The field of view can be adjusted to 10 X 10, 15 X 15, or 20 X 20 degrees and the patient does not need to be dilated.

The HRT software is especially designed to analyze the data and produce a stereometric map, detecting subtle changes in height and distances of the retina and optic nerve head. The HRT analysis provides disc area, cup and rim area, cup and rim volume, mean and maximum cup depth, three-dimensional shape of the cup, and the mean thickness of the retinal nerve fiber layer around the optic nerve head. The latest software versions of HRT use different analysis functions to classify a patient as normal or glaucomatous.

The HRT provides an extensive description of the optic nerve head, which can greatly contribute to the diagnosis of glaucoma and is an effective tool for following the progression of glaucoma. Analysis of the topographic maps of the retina can also be used to assess depth or elevation of the macula, as well as, for follow-up of various conditions including macula edema and/or holes.

A number of studies have demonstrated that the HRT is capable of identifying topographical difference in the optic disc, between individuals with glaucoma versus those without. Additionally, studies proved that this technology can reliably track changes in the optic nerve.

The Ophthalmic Disease Service and the School of Optometry purchased the Heidelberg Tomograph (HRT) over seven years ago. We recognized at that time the importance that glaucoma is an optic neuropathy and to make an early diagnosis, an instrument that could accurately describe the optic nerve and monitor for subtle changes in the features of the optic nerve may provide important diagnostic information. We appreciated at that time the limitations and subjectivity of ophthalmoscopy, both direct and indirect stereo, photographs and even monochromatic high contrast photographs in documenting the optic disc. At the time of our purchase we had one of ten of these instruments being used in the USA. The HRT is now the gold standard for imaging the optic nerve. We have performed over 10,000 scans. A less expensive version of the HRT is now available and is becoming more common in doctor's offices.

**Visual Fields**
Visual field testing is an important test in the diagnosis and management of glaucoma. It is used...
to confirm that glaucoma has affected the visual function, to evaluate the severity and to monitor for progression. For many years the standard of care has been static automated perimetry. The Indiana University School of Optometry's Ophthalmic Disease service has made a commitment to acquiring the latest technology that will provide the most sensitive detection of early visual field defects. Our standard visual field test for glaucoma is the Humphrey's 24-2 SITA Standard threshold strategy. This is only available on the Humphrey Field Analyzer II. We feel that this strategy may even be more sensitive than the original standard 24-2 threshold strategy and at the same time reduces patient fatigue and improves our clinic efficiency. We realize that there are limitations to this testing strategy. This testing for early retinal ganglion cells damage is relatively non-specific because there is a great deal of redundancy and overlap that exist in the receptive fields of ganglion cells. The unfortunate situation is that visual fields can be normal, while there is observable glaucomatous optic nerve damage and or loss of the nerve fiber layer.

We have used two new parametric tests for a couple of years now that aided us in detecting a visual field defect at an earlier point. The new tests are the short-wavelength automated perimeter (SWAP) (Figure 2) and the frequency doubling technology perimeter (FDP) (Figure 3). These tests are designed to test a subset of retinal ganglion cells which will hopefully reduce the number of retinal ganglion cells evaluated, reducing the overlap of the receptive fields and thus allow earlier detection of visual defects. Both of these tests have shown visual field loss in well-controlled studies when conventional testing shows no loss.

The SWAP testing uses a larger blue target (5mm) on a bright yellow background. This testing strategy is a separate program available on the HFA II and has a blue yellow stat Pac analysis. Even though a much more sensitive test, there are a few disadvantages that we have found with this testing strategy. SWAP requires a longer testing time, it has greater variability, patients often don't like the testing, there is need for retesting, it is affected more by cataracts and there is difficulty interpreting defects.

The FDP is an instrument developed by Welch Allyn and introduced by Humphrey systems. This testing is quite different than the conventional bowl perimeter. Patients are asked to look at a central black fixation dot on a video screen inside the instrument and are asked to press a button when they see shimmering bars appear anywhere in their field of vision. The bars appear for a brief second and then disappear, and then are presented at another location. The contrast can be increased or decreased until the target is perceived. All of our patients at the Optometry School's clinics have the screening test performed with this instrument at their primary care exam. This has proved to be a great screening device for not only glaucoma but also other visual field defects such as neurological and retinal defects. We use the full threshold mode that tests 19 locations and extends 30 degrees nasally. Where SWAP attempts to isolate the blue cones, the FDP technology isolates a subset of only a small number of retinal ganglion cells called M-y cells. By testing a sparse subset of the visual system, which seems to have a minimal amount of redundancy, we hopefully
can provide another test for early detection of glaucoma.

We have found that FDP has several advantages over other forms of perimetry: it is a small, portable lightweight device, it is highly resistant to blur up to 6 diopters, patients can wear their glasses, it has a rapid testing time of 3-5 minutes per eye, patients prefer the testing and instrument cost is reasonable (~$6,000). We often employ both of these tests on high-risk glaucoma suspects (ocular hypertensive and/or suspicious optic cupping) who have normal white on white Sita-Standard visual fields. We realize how difficult it is to make an early diagnosis of glaucoma in a significant number of patients. With this new technology (HRT, SWAP, and FDP) we can provide our patients with the most sophisticated technology to make an earlier diagnosis and/or detect progression of glaucoma.

I want to thank the Indiana University School of Optometry for their generous financial support and commitment in providing the Ophthalmic Disease Service with the latest technology to enhance our patient care.

References
The Past, Present, and Future of the School Screening Programs at Indiana University School of Optometry and in the State of Indiana

by Don W. Lyon, O.D. and Richard Meetz, O.D., M.S.

School Screening Program: 1957-1976

The Indiana University School of Optometry’s school screening program was established in 1957. The primary goal for the program then, as now, was “to detect children who have existing or potential vision problems that may interfere with performance in school and to have them receive appropriate eye care.” Secondary goals include allowing optometry interns to see a large number of “normal” eyes, to gain experience dealing with the pediatric population, and to educate the public on vision problems and the need for the early detection of these problems. The screening protocol is based upon the results of the Orinda study. This was the first study of vision screening jointly sponsored by optometry and ophthalmology groups and was completed during the years 1954 to 1956. The results showed that the most effective vision screening method was the Modified Clinical Technique (MCT). The components of the MCT include distance visual acuity, distance and near cover test, retinoscopy, and external/internal ocular health evaluation without dilation. When performed properly, the MCT can correctly identify from 90 to 98% of those children with visual problems, with an over referral rate from 1 to 4%. The basic form of the MCT has been used from the onset of the Indiana University school screening program. Additional tests, including near visual acuities and stereopsis measurements, have been utilized by the different directors of the program.

Robert Mandell, an optometrist who was one of the first IU physiological optics graduate students, was the initial director of the program. During the first year, all students (1,261 students) in grades one through twelve at ten schools were screened. Mandell coordinated the program until 1960 at which time IU faculty member Thomas Madden became the director. Madden continued as director until 1971. To comply with the recommendations from the Orinda study, Madden reduced the number of grades to include only the first, third and eighth, along with any children that were new to the school since the last vision screening. He also increased the number of schools that were participating in the program (Figure 1). Between 1972 and 1975 there were three different directors for the program, (John Shackle, 1972-73; Kenneth Lorenz, 1973-74; and William Carriger, 1974-1976). During this time period, the first mobile unit was purchased for use on the state’s Reading Effectiveness Program. In 1976, Richard Meetz was hired by Dean Gordon Heath to become the new director and was given the charge to further expand the program into a full time statewide clinic, to increase its educational impact and collect data on vision problems in Indiana school children.

School Screening Program: 1976-1994

During Meetz’s tenure most of the school screenings...
were performed inside mobile eye clinics which were a modified school bus (Figure 2) and later a Winnebago. This greatly reduced the setup time and provided a controlled testing area without disrupting school activities. The school screening teams would periodically take overnight trips in the mobile eye clinics and be on the road for several days with each intern spending an average of eight days per year performing screenings. On average, they screened six thousand students annually. During the 1981-82 school year the program reached its pinnacle for the number of children screened when a total of 7,577 children were seen over a seventy-seven day period.\(^3\) In the early 1990s the number of schools was reduced to accommodate increasing classroom teaching responsibilities at the School of Optometry. In 1995, Meetz had his faculty assignment modified to a greater didactic load at the School of Optometry and stepped down as director of the program.

**School Screening Program: 1995-1999**

In 1995, Dean Jack W. Bennett, assigned coordination of the program to the Binocular Vision/Pediatrics faculty. Bill Rainey, Chief of the Binocular Vision/Pediatrics Clinic, became the director of the program at that time. Due to the age and condition of the vehicles, the mobile eye clinics were no longer safe to use, and the screenings once again had to be completed inside the individual schools. During these last five years under the supervision of several faculty members and residents, approximately four thousand children in thirty schools have been screened annually.

**School Screening Program: 1999-2000**

During the 1999-2000 school year 3,954 children were screened in forty-three schools (listed below in Table 1). The Modified Clinical Technique was utilized to screen every student in kindergarten or first grade and all students who were enrolled in the school since the previous screening, (figures 3 and 4). The decision regarding whether first graders or kindergarten students were seen was left to the discretion of the individual school systems. Distance visual acuity was assessed on every third and eighth grader at the schools. Those third and eighth graders failing the visual acuity requirement were then sent to the retinoscopy and ocular health stations for further evaluation. The lowest number of students seen at any one school was 74 at Unionville Elementary School in Unionville, Indiana.\(^4\) The highest number seen was 259 students at Eastern School in Bloomfield, Indiana.\(^4\) Overall, 15.1%, or 597 students were referred from the school screenings performed over the last school year.\(^4\) The referrals were made based upon the American Optometric Association’s referral criteria for school screenings listed in Table 2 below.\(^5\) The majority of the referrals made were for myopia (30.0%). The next highest referral rate was for hyperopia (26.6%).\(^4\)

**Screening Follow-Up**

After each individual screening is performed, results are sent to each school. Once the school receives and processes the results they notify the parents of those children who failed. Parents are informed only that their child requires further testing and needs to see an eye and vision care professional for a comprehensive eye exam. The results of that exam are sent back to the school before the end of the school year. Prior to 1996, each school submitted an annual vision testing report to the Indiana State Board of Health at the end of each school year. These reports included the number of children in each grade tested, the number of students failing the vision screening, and the number of students who received the appropriate follow-up care. Due to a reorganization of the Indiana State Department of Health in 1996, these reports are no longer generated. Instead the Indiana State Department of

<table>
<thead>
<tr>
<th>School System</th>
<th>City</th>
<th># Schools</th>
<th># Screened</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bloomfield</td>
<td>Bloomfield</td>
<td>2</td>
<td>490</td>
</tr>
<tr>
<td>Brown County</td>
<td>Nashville</td>
<td>4</td>
<td>228</td>
</tr>
<tr>
<td>Metro School District of Shakamak</td>
<td>Jasonville</td>
<td>1</td>
<td>77</td>
</tr>
<tr>
<td>Mitchell Community Schools</td>
<td>Mitchell</td>
<td>1</td>
<td>192</td>
</tr>
<tr>
<td>Monroe County Community School Corp</td>
<td>Bloomington</td>
<td>13</td>
<td>1520</td>
</tr>
<tr>
<td>Montessori</td>
<td>Bloomington</td>
<td>1</td>
<td>104</td>
</tr>
<tr>
<td>North Davies/Raglesville</td>
<td>Elora</td>
<td>2</td>
<td>106</td>
</tr>
<tr>
<td>Orleans Community Schools</td>
<td>Orleans</td>
<td>1</td>
<td>86</td>
</tr>
<tr>
<td>Paoli Community Schools</td>
<td>Paoli</td>
<td>1</td>
<td>123</td>
</tr>
<tr>
<td>St. Charles</td>
<td>Bloomington</td>
<td>1</td>
<td>126</td>
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<tr>
<td>Unionville Schools</td>
<td>Unionville</td>
<td>1</td>
<td>74</td>
</tr>
<tr>
<td>Warren Township</td>
<td>Indianapolis</td>
<td>12</td>
<td>596</td>
</tr>
<tr>
<td>White River Township</td>
<td>Lyons</td>
<td>2</td>
<td>232</td>
</tr>
</tbody>
</table>

Table 1. School systems screened in 1999-2000 school year and number of students seen.
Education sends a one page check-off form to the school system for completion if a vision screening has been performed. The school is instructed to keep all records of the screening on site. The question then becomes whether or not the primary goal "to detect children who have existing or potential vision problems that may interfere with performance in school and to have them receive appropriate eye care"1 is being achieved. In order to answer that question we need to take a broader look at the school screening program on a state level.

State Screening Program

As stated above, the Indiana State Department of Health was re-organized in 1996. Therefore, no source of information on the school screening program at a state level exists after the 1995 school year. The only complete information that we have spans the school years of 1991-1995, with all previous data reportedly having been destroyed. The data in Table 3 are from an average of 95.2% of the public school systems reporting to the state over the 1991 to 1995 four-year period. This information shows that during this period an mean of 37,747 students were referred from vision screenings annually. An annual average of 14,399, representing 38.2% of the referrals, did not have the recommended comprehensive eye and vision examinations. These numbers do not include the 4.8% of the public school systems not reporting to the state or those school systems receiving a waiver from the state. This means approximately 14,400 students did not receive the appropriate follow-up eye care they deserve, and this may be a conservative estimate.

Considering this data we can ask does the statewide school screening program in its present form reach its primary goal? The goal "to detect children who have existing or potential vision problems that may interfere with performance in school" is probably being met for the first graders or kindergartners who receive the full MCT screening. The goal that they "receive appropriate eye care" is certainly not being met. Of those children who are referred by the school screening program, close to forty percent annually do not receive the necessary vision care. It is also noteworthy that not every child in the grades that are required by state law to have a screening is getting the appropriate visual screening. There are some school districts which receive waivers from the state so they do not have to use the Modified Clinical Technique to evaluate the students. The question then is, what can we change so the school screening program meets its primary goal on a statewide level?

Building a Better Program

One way is to change the perceptions that parents have about school screenings through education. Parents and school nurses should be educated on both the limitations of school screenings and the importance of early comprehensive eye and vision examinations to detect vision problems. To accomplish this, local optometrists should attend PTA meetings to give lectures about pediatric eye care and the impact vision problems may have on school performance. They should also perform school screenings in their area. The "Indiana School Vision Screening Guidelines, 3rd Edition" is an excellent resource that can assist optometrists and the school communities in organizing a school screening or improving an already existing school screening program in their local schools.10 Optometrists may obtain a copy of the guidelines by contacting the Indiana Optometric Association at 317-237-3560. This method is a "quick fix" to the problem and should enable more children to be seen but it will not solve all of the problems with the current program. Public Law 140-1986, which is the vision testing law for elementary schools, was originally designed to be a

<table>
<thead>
<tr>
<th>Table 3. State school screening program 1991-1995</th>
</tr>
</thead>
<tbody>
<tr>
<td>School Year</td>
</tr>
<tr>
<td>-----------------------------------------------</td>
</tr>
<tr>
<td>Total students screened</td>
</tr>
<tr>
<td>332,650</td>
</tr>
<tr>
<td>Total students referred</td>
</tr>
<tr>
<td>38,144</td>
</tr>
<tr>
<td>11.50%</td>
</tr>
<tr>
<td>Total number of referrals not seen by eye doctor</td>
</tr>
<tr>
<td>13,109</td>
</tr>
<tr>
<td>34.4%</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Table 2. AOA school screening referral criteria. Kindergarten/First Grade</th>
</tr>
</thead>
<tbody>
<tr>
<td>Visual Acuity-Distance Unable to read 20/30 either eye</td>
</tr>
<tr>
<td>Visual Acuity-Near Unable to read 20/40 with both eyes</td>
</tr>
<tr>
<td>Hyperopia Refraction of +2.00 D or greater</td>
</tr>
<tr>
<td>Myopia Refraction of -0.75 D or greater</td>
</tr>
<tr>
<td>Astigmatism Refraction of 1.00 D or greater</td>
</tr>
<tr>
<td>Anisometropia Refraction of 1.00 D or greater in inequality</td>
</tr>
<tr>
<td>Heterotropia Any tropia measured</td>
</tr>
<tr>
<td>Esophoria &gt;5Ã at distance, &gt;10Ã at near</td>
</tr>
<tr>
<td>Exophoria &gt;5Ã distance or near</td>
</tr>
<tr>
<td>Vertical Deviation 2 or greater</td>
</tr>
</tbody>
</table>
stop-gap measure to minimize an existing problem, not to solve it. Some schools will still be granted waivers and there still will be children not receiving the follow-up care they need. The best solution to the problem is to have a law which stipulates that any child attending public school must have an eye and vision examination before entering kindergarten or first grade.

Getting a law of such sweeping magnitude passed may seem to be an impossible accomplishment. However, Kentucky has recently become the first state in the country to enact such a law. This law states that all children are required to have eye and vision examinations prior to entry into pre-school, Head Start, or kindergarten. The law took effect on July 15, 2000 and impacts all children entering those programs this fall. The Kentucky law requires that documentation of the required examination be received at the schools by January 1 following entry into school. This law, according to Darlene W. Eakin, Kentucky Optometric Association Executive Director, dictates that the eye and vision examinations must be performed by an optometrist or ophthalmologist, and that it is bundled in with other medical examinations and immunizations that each child will be required to have before entering school. Given Kentucky’s success, there is no reason that similar legislation cannot be passed in other states as well.

Optometrists realize the importance of good eye and vision care and the impact that vision problems can have on school performance. As a profession we need to make parents and politicians realize the importance of eye and vision care. They need to recognize that it is better to discover a vision problem before it affects a child’s school performance rather than detecting it when the child is in third or fourth grade and has already suffered academically. The authors believe that we neither could nor should try to accomplish this by ourselves. As they did in Kentucky, we need to work with the other health care professions that deal with pediatric populations. We need to make children’s health care, specifically vision care, an important issue to those who create and pass the laws of this state. There is no quick or easy solution to the problem but as we can see in the above data (Table 3), the current program obviously is not fulfilling the need of school children in the state of Indiana because children who are referred for vision care are often not receiving it. We as a profession have the power to change the way people view the eye and vision care of children but only if we take the first step.

References

Editor’s note:
Don W. Lyon is a 1999 graduate of the Indiana University School of Optometry. Following his graduation, he completed a one-year residency in Binocular Vision/Pediatrics at IU. His responsibilities included re-organizing the IU school screening program and being an on-site optometrist for the program during the 1999-2000 school year.

Figure 4: Stereopsis being performed by a third year intern Tim James at Highland Elementary School 1999-2000 School year
Article of Interest: Receded Near Point of Convergence and Heterophoria Reported to be Less Common in Preschool Children than in School-age Children

Reviewed by David A. Goss, O.D., Ph.D.


This paper presents a cross-sectional study of near point of convergence, amplitude of accommodation, and near phoria in over 400 children between the ages of 1 and 17. Relatively little data were previously available for these tests for preschool children. For inclusion in the study, children had to have approximately emmetropic refractive errors (0 to +1.00 D), absence of any ocular disease, measurable stereopsis, and good near visual acuity.

A standard objective push-up near point of convergence (NPC) test was administered to 485 children. All children seven years of age and younger had an NPC of 5 cm or closer. An NPC of more than 5 cm was only found in children 8 years of age or older. The mean NPC was about 1 cm at 2, 3, 4, and 5 years of age. Then it gradually increased to about 4 cm at 12 years of age. The variance of the NPC also increased with age. About 10% of twelve to fourteen year old children had NPC breaks at 9 cm or greater.

Amplitude of accommodation was tested in 405 children. Amplitude was tested by a push-out procedure. Symbol targets were held very close to the eye and then moved gradually away from the eye. In other words, this was a "blur to first detection" procedure rather than a "clear to first blur" procedure as in the standard push-up amplitude test. The push-out procedure was used because of the difficulty of small children in understanding the concept of blur. And, of course, symbols were preferable to letters for easier recognition by small children. Amplitude of accommodation decreased with age. The slope of the linear regression equation of amplitude as a function of age was -0.31 D/yr. This is very close to the slope of -0.3 D/yr in Hofstetter's expected amplitude formula, even though Hofstetter's formula was derived using adults and children. The mean binocular amplitude of accommodation was about 15 D at two years of age and about 11 D at 14 years of age.

Testing of heterophoria was done with a modified Maddox wing test. The Maddox wing is a phoria measuring device which has had some popularity among British optometrists. A septum provides some separation of the field of vision of the two eyes. The patient reports where a marker, typically an arrow, seen by one eye crosses a numeric scale seen by the other eye. It has been pointed out that dissociation of the two eyes is not total, so the results are not likely to be exactly comparable to other dissociated phoria measurements. For this study pictures were used instead of numbers and a moveable pointer was used instead of an arrow to make the test easier for small children. The test distance was 25 cm. This test was done on 268 children between the ages of 2 and 15 years.

Orthophoria was found in almost all (over 95%) of children younger than five years of age. Orthophoria was found in about 80% of five-year-olds. The prevalence of orthophoria declined to a little over 40% at eight years of age, and was around 50% at 9 to 12 years. Variance increased considerably from preschool age to school-age, with both exophoria and esophoria becoming more common. The mean phoria did not change very much. It was 0.04 prism diopters exophoria for preschoolers and 0.45 prism diopters exophoria for school-age children.

It is interesting that a study by David Rich, IU Optometry Class of 2000, and now the IU Binocular Vision and Pediatrics Resident, and Bill Rainey, IU optometry faculty member, appears to be consistent with the Chen et al. study. Rich and Rainey have found that for preschool children in our clinic accommodation and non-strabismic vision disorder diagnoses are much less frequent than in school-age children. We could ask whether these disorders are
harder to diagnose in preschoolers or whether a lower prevalence would be due to a lower variance in accommodation and vergence test results in preschoolers than in school-age children, as found by Chen et al.

Is it coincidence that receded NPC and heterophoria become more common about the time children enter school? Chen et al. speculate that “the increased incidence of heterophoria at near after children start school might be related to near work.” With regard to their NPC findings, the authors conjecture that “the increasing incidence of a remote NPC with increasing age in this study might be due to the near work demands of primary school which might create a different level of near point stress than the near work conditions in pre-school years. Alternatively, it could also be argued that small children live in a closer visual world than school children, and this environment might help to ‘train’ good convergence.”

The Chen et al. study raises a number of questions. How accurate and reliable were the measurements on the preschool children? Could the results be explained by normal development rather than differences in visual activity with increasing age? Nevertheless, it does suggest that some of the theories concerning near point stress producing vision problems10 are worth re-examining.

References
New Faculty

Indiana University School of Optometry has recently appointed six new faculty members. Drs. Rowan Candy, S.P. Srinivas, and Suresh Viswanathan are tenure track faculty involved in teaching and research, while Dr. Elli Kollbaum’s primary responsibility will be clinically oriented teaching at the Bloomington clinic and Dr. Don Lyon’s will be teaching clinical optometry part-time at the Indianapolis clinic. Dr. Cyndee Foster has assumed the position as Director of our Guanajuato, Mexico clinic. We are pleased to have this opportunity to introduce these six outstanding individuals to you.

Rowan Candy, M.C. Optom., Ph.D.

Dr. Candy joined the faculty at the IU School of Optometry in August, 2000, as an Assistant Professor of Optometry. Her initial teaching assignment will be to develop and administer an infant vision clinic as well as teaching in the clinic. Dr. Candy received her professional optometric education at the University of Wales, Cardiff and her Ph.D. in Vision Science from the University of California-Berkeley. Her primary area of research has been the development of spatial vision in human infants. In the past two years, she has completed two outstanding projects demonstrating the importance of post-natal visual experience in brain development which have been published in Vision Research. Dr. Candy’s career goals are: (1) to conduct research in normal and abnormal visual development; (2) to translate her research into clinically-useful tools and information; (3) to encourage awareness of pediatric optometry throughout the optometric profession; (4) to develop a clinic and referral center for the specialized assessment of infants, older children, and adults with developmental visual disorders and patients with communication or cooperation problems.

Don Lyon, O.D.

Dr. Lyon was appointed as a Visiting Clinical Assistant Professor in the IU School of Optometry. Dr. Lyon has a joint appointment with the School of Optometry and the IU School of Medicine, Department of Ophthalmology. He is working in the Indianapolis Eye Care Center and also seeing patients in the Pediatric Section in the Department of Ophthalmology at the IU Medical Center. He graduated from the IU School of Optometry in 1999 and just completed a residency in Binocular Vision/Pediatrics here at the school. Dr. Lyon has worked extensively in both the Bloomington and Indianapolis clinics in the pediatrics area and was responsible for the school vision screening program during the past year. He and his wife, Kathie, make their home in Indianapolis.

Elli J. Kollbaum, O.D.

Dr. Kollbaum has been appointed as a Clinical Assistant Professor in the IU School of Optometry and is involved in clinical teaching. She graduated from the IU School of Optometry in 1997 with honors, receiving numerous awards during her four years in optometry school. She then completed a residency at the Chicago VA Hospital. Prior to coming to IU, Dr. Kollbaum was in private practice in Ames and Story City, Iowa, practicing full scope optometry, ocular disease management, surgical co-management, contact lens fitting, pediatric care, geriatric care, and low vision. Dr. Kollbaum and her husband, Dr. Pete Kollbaum (O.D. ’99), are excited to be returning to Bloomington and Indiana University. Pete will work on a Ph.D. degree in Vision Science and Physiological Optics, and will hold an appointment as an Associate Instructor in the clinics.

S. P. Srinivas, Ph.D.

Dr. Srinivas joined the faculty at the IU School of Optometry on June 1, 2000, as an Assistant Professor of Optometry. He previously held a research position and taught systemic and ocular pharmacology at the School of Optometry at the
Dr. Srinivas has a Ph.D. in chemical engineering from Drexel University, Philadelphia, PA and did a post-doc at Stanford University in one of the leading corneal research centers in the world under Dr. David Maurice. He then did a second post-doc at the University of California-Berkeley. He is highly regarded as both a researcher and teacher and has had numerous publications in leading scientific journals. He will be teaching pharmacology in the School of Optometry and doing research in the areas of drug delivery to the eye and on corneal swelling.

**Suresh Viswanathan, M.C. Optom., Ph.D.**

Dr. Viswanathan joined the faculty at the IU School of Optometry in August, 2000 as an Assistant Professor of Optometry. He will be teaching the physiology portion of the Systemic Physio-Pharmacology courses and will be setting up and working in the electro-diagnostic clinical service. Dr. Viswanathan received his professional optometric education at the Elite School of Optometry, Madras, India, his Master of Science in Clinical Optometry from Pacific University College of Optometry, and just received the Doctor of Philosophy in Physiological Optics/Vision Science from the University of Houston. Prior to coming to Indiana University School of Optometry, Dr. Viswanathan was a teaching assistant in neuro-anatomy, clinical procedures, binocular vision/ocular motility, ocular anatomy and photometry laboratory courses. He is interested in both basic and clinical research and will continue to study the origins of the different components of the electroretinogram (ERG) and in using the ERG as a tool to understand the pathophysiology of retinal diseases in patients and animal models. Dr. Viswanathan was recently married to Tracy Nguyen, O.D.

**Other Items of Interest**

**Dr. Bob DeVoe** retired in December 1999, after a career of teaching and research that spanned over 38 years. Prior to coming to Indiana University in 1983, Dr. DeVoe spent 22 years on the faculty of the Department of Physiology at the John Hopkins University School of Medicine. He taught physiology at the IU School of Optometry for several years. Then in 1997 he and Dr. Sally Hegeman combined the systemic physiology class and the pharmacology class into a course called Systemic Physio-Pharmacology. Dr. DeVoe continues to be active as an Emeritus Professor, working to finish data digitization and analysis for a number of papers. He is also active in his church, as well as gardening and traveling with his wife.

**Dr. Ron Jensen** retired on June 30, 2000, after more than twenty years at IU where he served most of those years at the School of Optometry as Assistant to the Dean. Over the years he worked in student affairs, media liaison, fundraising, alumni relations, professional relations, and served as safety officer. His plans for retirement include community participation in groups such as Habitat for Humanity, an active role in his church, spending more time with family, and periodic traveling with his wife.

**Dr. Sally Hegeman** retired in December, 2000, after 22 years of teaching pharmacology at the IU School of Optometry. She came to Indiana University after receiving her Ph.D. from the University of California. Dr. Hegeman has been recognized for outstanding teaching by her students and fellow faculty, having been nominated for the Professor of the Year award eleven times and selected for the Teaching Excellence Award in 1997-1998 and 1999-2000. She has also taught many postgraduate and continuing education courses for the School of Optometry. She assisted the Indiana Optometric Association in developing the Optometric Drug Formulary and has consulted with several state associations on optometric drug legislation. In retirement, she plans to finish writing two textbooks, continue consulting, work in her garden, participate in the League of Women Voters and travel.

For the second year in a row, the Indiana Journal of Optometry received the 2nd Place award for Best State/Regional Journal from the Optometric Editors Association for 1999. **Drs. Larry Thibos and Don Miller** got Third Place in the Best Technical Article competition for their article on electronic spectacles. **Doug Freeman** received Third Place in the Best Non-Technical Article category for his article, *Indiana Optometrists and the Virtual Vision Library*. 
The **Class of 2004** started classes this fall at IU School of Optometry. There are 67 students selected from a pool of over 400; 37 are Indiana residents and 30 are non-residents from 12 other states and 3 other countries. There are 31 men and 36 women averaging 24 years of age, ranging from 21 to 39. The mean cumulative undergraduate GPA is 3.47. Eighty-five percent of the admitted students have a bachelor's degree.

He is also the Vice-Chair of the Association of Optometric Contact Lens Educators and attended the Executive Committee meetings of both organizations held during the American Academy of Optometry annual meeting.

**Dr. Joe Bonanno** received the prestigious Glenn Fry Award at the American Academy of Optometry annual meeting in Orlando in December. The award honors a distinguished scientist or clinician for his or her current contributions in optometric research.

The Cornea and Contact Lens Section awarded **Dr. Ted Grosvenor**, who recently retired from the IU faculty, the Founders' Award, presented in recognition of an individual for his or her significant lifetime contributions to the cornea and contact lens field by virtue of publications, lectures, and research efforts.

**Dr. Mark Braun**, a faculty member whose teaching is divided between the IU School of Optometry and Medical Sciences, was elected to the Faculty Colloquium on Excellence in Teaching this past spring and received the outstanding instructor award for the Medical Science Program for the 1999-2000 school year.

**Dr. Steve Hitzeman** received the Indiana Optometric Association's Optometrist of the Year award for 2000. He was chosen from a field of 900 Hoosier Optometrists. He is the Director of Clinics and specializes in sports vision.

**Dr. Ed Marshall** was elected to the American Public Health Association Executive Board at the APHA meeting in Boston in November. He is the first optometrist in the 128 year history of the APHA to be elected to the Executive Board.

**Dr. Marshall** has also received the State Health Commissioner's Award, the highest health award in the state of Indiana.
Dr. Shaban Demirel lectured this past summer at three meetings held in Australia: the Victorian College of Optometry Continuing Education Program; the Queensland University of Technology School of Optometry Seminar Series; and the Melbourne University Department of Optometry Departmental Seminar Series.

Dr. Gerald Lowther has been given a two-year appointment as Departmental Academic Advisor for the Department of Optometry, Hong Kong Polytechnic University. He also was appointed to the National Board of Examiners in Optometry.

Dr. Sarita Soni was an invited lecturer at the Essilor 2000 Presbyopia Symposium in Portugal in June and at the International Society of Contact Lens Specialists in Burgenstock, Switzerland in September. She has been elected to the National Academies of Practice as a Distinguished Scholar. She was also recently appointed by Parent Magazine as a consultant to the editors on children’s vision research.

Doug Freeman, IU School of Optometry Head Librarian, was appointed Co-Chair of the ASCO Informatics Special Interest Group.

Dr. Brad Sutton, IECC Director, has been appointed to the Board of Prevent Blindness Indiana.

Dr. Larry Thibos and his family recently returned from a six months sabbatical at the optometry school in Auckland, New Zealand.