

## The Use of Vertical Yoked Prisms in College of Optometrists in Vision Development Members

Stanley W. Hatch, OD, MPH, FAAO, FCOVD  
Salus University, Pennsylvania College of  
Optometry, Philadelphia, Pennsylvania

### ABSTRACT

#### Background

Vertical yoked prisms for treatment for binocular, accommodative, refractive, gait, posture, and behavioral conditions has been recommended by various authors. Few clinical trials have assessed the safety and efficacy of this practice. The purpose of this study is to estimate the frequency of vertical yoked prism use in vision therapy and spectacle prescriptions in a sample of College of Optometrists in Vision Development (COVD) membership.

#### Methods

Multiple invitations to participate in a prospective anonymous survey were sent to all COVD members by email in October 2019.

*Correspondence regarding this article should be emailed to Stanley W. Hatch, OD, MPH, FAAO, FCOVD, at [shatch@salus.edu](mailto:shatch@salus.edu). All statements are the author's personal opinions and may not reflect the opinions of the College of Optometrists in Vision Development, Vision Development & Rehabilitation or any institution or organization to which the authors may be affiliated. Permission to use reprints of this article must be obtained from the editor. Copyright 2021 College of Optometrists in Vision Development. VDR is indexed in the Directory of Open Access Journals. Online access is available at [covd.org](http://covd.org). <https://doi.org/10.31707/VDR2021.7.2.p137>.*

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### Results

One hundred twenty-three COVD members participated. Eighty percent use vertical yoked prisms in vision therapy and 83% prescribe vertical yoked prisms in habitual spectacle prescriptions. Base down and base up across a range of powers are used about equally in therapy. Base down is prescribed more commonly for esophoria and myopia. Base up is prescribed more commonly for exophoria. Base down and base up are prescribed about equally for oculomotility, perceptual conditions, posture and behavioral conditions such as autism. Sixty three percent of respondents plan to wean patients off the prism prescriptions.

### Conclusions

Vertical yoked prisms are commonly used in vision therapy and prescribed in habitual spectacle prescriptions in this sample of COVD members. Given the high frequency reported, larger controlled studies on safety and efficacy are in order.

Vertical yoked prisms to treat binocular, accommodative, refractive, gait, posture, and behavioral conditions have been recommended by many optometrists.<sup>1-7</sup> In addition to image deviation, vertical yoked prisms may affect visual perceptual space through small changes in magnification along the base apex line. Light traveling from a substance of low index of refraction (air) through a substance of higher index of refraction (plastic spectacle lens), is slowed causing the image to appear closer and larger. The thicker part of the lens affects the light more than the thinner part causing asymmetric linear magnification. If the base of the prism in a standard CR39 plastic lens is 9 mm thick and the apex is 6 mm, the magnification is 1.057X and 1.033X respectively. Thus, the image through the base is slightly larger than the image through the apex.

There may be other physical properties at work. According to a lecture by Dean (Dean M. Spatial transformation properties of prisms.

COVD Annual Meeting 04/15/2021) prisms affect light through variable dioptric deviation (depending on the superior/inferior angle relative to the eyes) and asymmetric angular deviation (depending on differences in incident angles of reflected object light ray point origins), in addition to asymmetric linear magnification. It is proposed that these properties result in expanded visual space (perceptual space, perceptual field) towards the apex.<sup>1-3</sup> It is also posited that the emergent visual response changes posture, perception, vergence, accommodation, oculomotility, and myopia progression. Leslie et al,<sup>8</sup> Press,<sup>9</sup> and Harris<sup>10</sup> have described the history, principles and applications in greater detail.

Yoked base down (BD) prisms theoretically lift the eyes up, expand perceptual space, stimulate more open body posture, encourage divergence, and relax accommodation. Yoked BD prisms are recommended for patients with esophoria, accommodative excess, and myopia.<sup>1-3</sup> Improvements in gait for toe walking have been reported.<sup>4</sup> In contrast, yoked base up (BU) prisms are theorized to depress gaze, compress perceptual space, center body posture, encourage convergence, and stimulate accommodation. BU is recommended for patients with exophoria, accommodative insufficiency, and hyperopia.<sup>1-3</sup>

Base up and base down yoked prisms are sometimes recommended for patients on the autism spectrum to improve behavior, specifically eye contact, posture, gait, peripheral vision awareness, and visual spatial skill.<sup>5</sup> Coulter reviewed the limited literature in this area and found some support for either BD or BU on visual behavior and visual motor integration tasks.<sup>11</sup> Kaplan et al<sup>6,7</sup> and Carmody et al<sup>12</sup> assert that persons on the autism spectrum may have deficient ambient (peripheral awareness, parvocellular pathway) visual systems. Their research included placebo controls in their initial assessment, but their prescriptions were based on subject response. Thus, subjects were dispensed either yoked BU

or BD for the same condition. Why they found a slight majority of patients improved with BU and a significant minority improved with BD has not been addressed. Taub et al.<sup>13</sup> recently reported two patients with attention problems and autism spectrum disorder who responded well to vertical yoked BU first in office with oculomotility and visual motor tasks then with 2.00Δ BU prescribed for full time wear. Other case reports found no improvements in autism behavior or posture with vertical yoked prisms.<sup>14,15</sup>

Vertical yoked prisms have also been prescribed for post-concussion or traumatic brain injury.<sup>16</sup> Traumatic brain injured patients often have multiple and unique visual field defects, visual neglect, photophobia, vestibular dysfunction, blurred vision, accommodative disorders, binocular disorders, and headache. Due to the uniqueness of each case and the acquired structural damage, this project did not address vertical yoked prism use in traumatic brain injured patients. The present study was designed to investigate the frequency of vertical yoked prism in more common functional vision conditions without visual field defects, extra ocular muscle palsies, or accommodative paresis.

It is surprising that more controlled studies do not exist given that lectures and published reports recommending vertical yoked prism date prior to 1960. Hock and Coffey<sup>17</sup> reported that 15Δ BD led to spatial localization 1.85% closer than plano lenses while 15Δ BU resulted in 1.75% farther spatial localization. The direction of change was consistent with a real space task (bean bag toss) and a disparity induced task (Quoits Vectograms).<sup>18</sup> These results seem to contradict the theory that BD expands and BU compresses visual space. Vertical yoked prism can change posture depending on the magnitude. Sheedy and Parsons conducted a clinical trial of 24 visually normal young adult subjects randomized into two groups.<sup>19</sup> One group wore no prism or 2Δ BD for 2 weeks. The second group wore no prism or 4Δ BD for 2 weeks. In both cases, subjects were masked regarding prism status and half the group wore prism first

and no prism second and the opposite sequence for the other half. Subjective and objective measures yielded no difference between no prism and 2Δ BD for acceptance or posture, but 4Δ BD yielded an average of 1.74 degrees upward head posture and “nearly unanimous rejection” of 4Δ BD. Errington et al investigated vertical yoked prism on gait in normal young adults and found either slower gait or no affect.<sup>20</sup> Schmid et al,<sup>21</sup> conducted a well-controlled random assignment cross sectional study on binocular and accommodative function with 4Δ BU and BD, 8Δ BU and BD, and no prism in 45 young adults without binocular vision problems. They found no effects on phoria, vergence, negative relative accommodation, or positive relative accommodation. They found a small, but statistically significant increase in accommodative stimulus response function with BU.

It seems, therefore, that contradictions exist between theory, case reports, and controlled studies. To justify new research, studies are needed to document the prevalence of conditions and treatments and the public health burden of untreated conditions. Prevalence of conditions and public health burden have been reviewed elsewhere.<sup>22</sup> The purpose of this study is to estimate the prevalence of vertical yoked prism as treatment in a sample of College of Optometrists in Vision Development (COVD) members.

## METHODS

This prospective anonymous survey study was approved as exempt research by the Salus University Institutional Review Board and permission for distribution was granted by the COVD Board of Directors. COVD was chosen because it is the largest organization of developmental optometrists and the use of vertical yoked prisms is included in its education meetings, in articles in *The Journal of Vision Development and Rehabilitation* and its predecessor, *The Journal of Optometric Vision Development*. The questionnaire was reviewed by a social scientist with a PhD in evaluations, piloted to several Salus University

Pennsylvania College of Optometry binocular vision faculty members, and revised for clarity prior to the study. Email invitations with a link to SurveyGizmo (now known as Alchemer, <https://www.alchemer.com>) were sent to all COVD members during the first two weeks of October 2019. A total of 123 responded.

## RESULTS

Table 1 lists the demographic information of participants. Most respondents had practices with large numbers of active vision therapy patients.

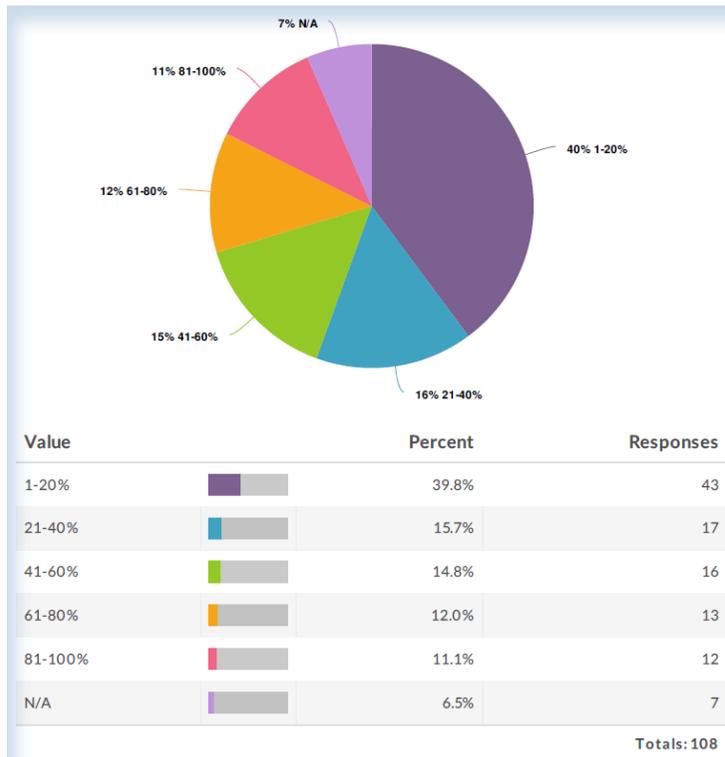
**Table 1: Characteristics of Survey Participants**

Topic	Percent Responses	
Typical number of hours per week in practice	0-25 hours	18%
	26-40 hours	66%
	>40 hours	16%
Number of comprehensive eye exams performed in a typical week	0-10	13%
	11-20	16%
	21-30	20%
	31-40	25%
	41-60	16%
	>61	10%
Number of patients receiving office-based vision therapy in an average week	0-2	12%
	3-5	8%
	6-9	12%
	10-15	11%
	16-25	23%
	>25	34%

The first section of the survey investigated the use of vertical yoked prisms in vision therapy. Prism therapy was a common part of vision therapy programs (80% of respondents) as well as home therapy only patients (54%). The proportion of patients enrolled for whom vertical yoked prisms was part of therapy is shown in Figure 1. Figure 2 shows the frequency of BD prism versus BU used in office-based therapy. Just under half of respondents use BD and BU equally. Eighteen percent of respondents use BD more frequently than BU and 21% use BU more frequently than BD. Table 2 shows the range prism powers from 1 to 12Δ and the proportion

**Table 2: Range and Proportion of Magnitude of Prism Power in Prism Diopters Used During Office Based Vision Therapy**

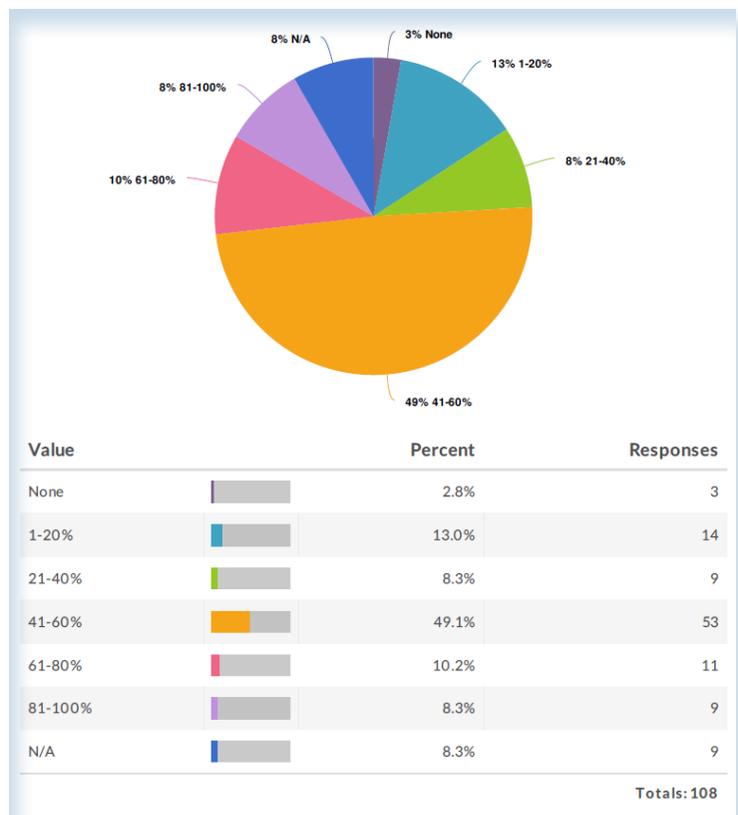
Power in prism diopters	% Respondents for each
1	14.1%
2	37.4%
3	22.2%
4	39.4%
6	36.4%
8	43.4%
10	56.6%
12	34.3%
Other	30.3%



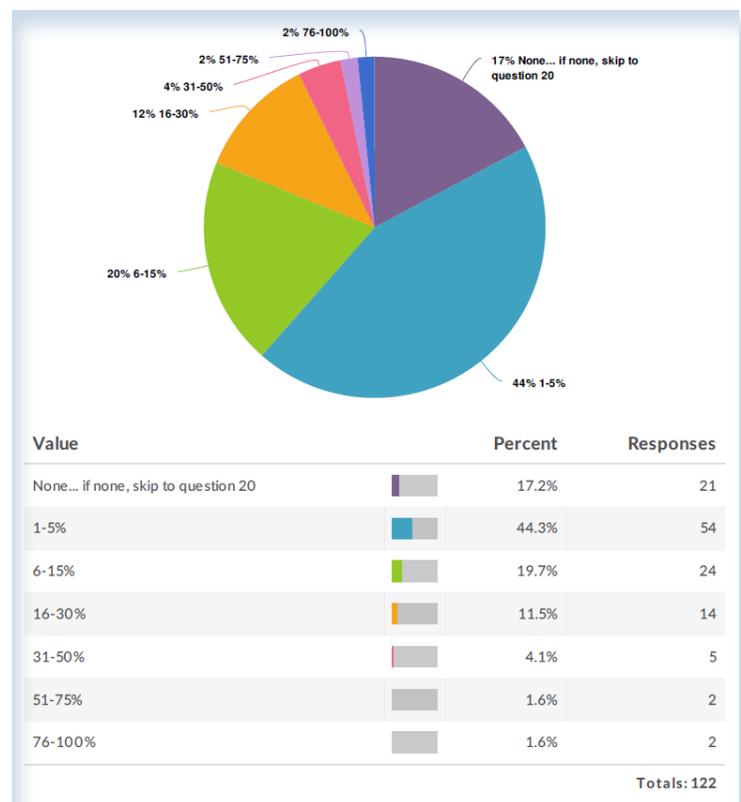
**Figure 1.** Percent of Office Based Vision Therapy Patients Using Vertical Yoked Prisms in Therapy.

of respondents that use each power. Seventy six percent of respondents use vertical yoked prism in therapy with patients on the autism spectrum.

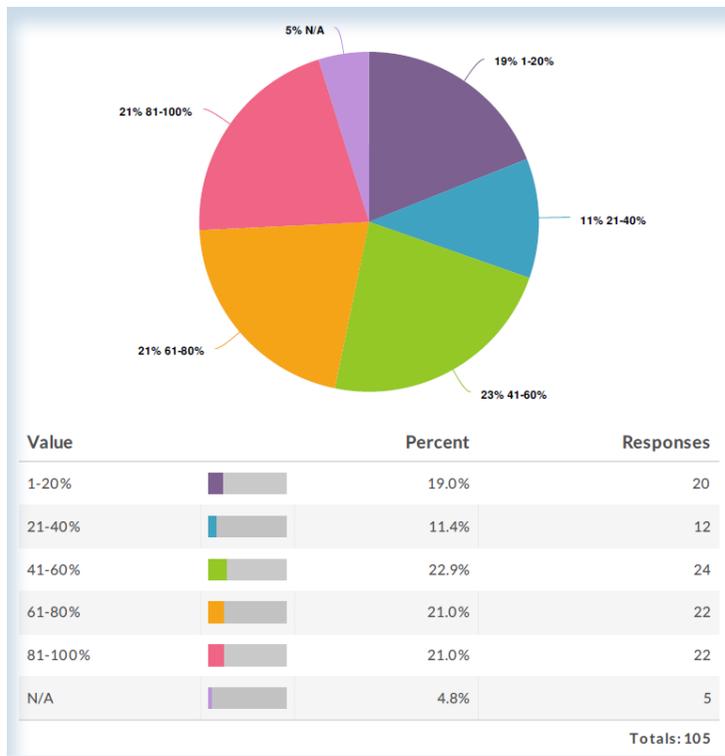
The second section of the survey investigated prescribing patterns of vertical yoked prisms. Eighty three percent of respondents prescribe vertical yoked prisms for habitual spectacle wear. Of those 83%, Figure 3 reveals the proportion of respondents and the percent of patients who typically receive vertical yoked prisms in their spectacle prescriptions. Figure 4 shows the percent of BD prescriptions by frequency. Figure 5 reveals the frequency of the most common prism powers prescribed.



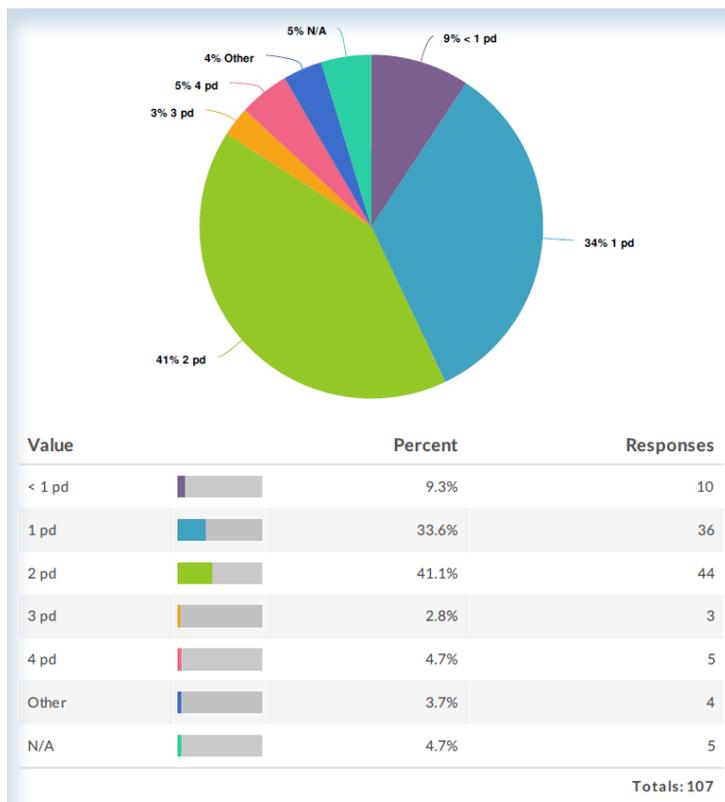
**Figure 2.** Proportion of Therapy Sessions Employing Base Down Vertical Yoked Prisms.



**Figure 3.** Proportion of Spectacle Prescriptions that Include Vertical Yoked Prisms.



**Figure 4.** Proportion of Vertical Base Down Yoked Prisms in Spectacle Prescriptions.



**Figure 5.** Magnitude of Vertical Yoked Prism Power in Prism Diopters Typically Prescribed in the Initial Spectacle Prescription.

The percent of providers who intend to wean patients off the prism was 63%, those who intend the prism to be permanent was 29%, and 9%

responded not applicable. Of the respondents who intend to wean off the prism, 33% planned to wean off after more than 12 months, 21% in 8-12 months, 20% in 4-8 months, 12% in 2-4 months and 9% in 0-2 months.

**Table 3: Conditions Where Base Down Vertical Yoked Prisms may be Prescribed in Spectacles.**

Condition	Proportion who Rx
Esophoria	67.6%
Visual perceptual conditions	56.9%
Oculomotility dysfunction	33.3%
Myopia	35.3%
Exophoria	22.5%

**Table 4: Conditions Where Base Up Vertical Yoked Prisms may be Prescribed in Spectacles.**

Condition	Proportion who Rx
Exophoria	57.6%
Visual perceptual conditions	47.5%
Oculomotility dysfunction	33.3%
Esophoria	14.1%
Myopia	7.1%

Tables 3 and 4 list the percent of conditions where BD and BU, respectively, are prescribed. The prescribing pattern generally follows that suggested in most articles: BD for esophoria and myopia, and BU for exophoria. Interestingly, 33% prescribe BD for oculomotility dysfunction and 33% prescribe BU for oculomotility dysfunction; 57% prescribe BD for perceptual conditions and 48% prescribe BU for perceptual conditions. The survey did not determine if prescription pattern depends on trial patient response, so the choice of BD or BU for oculomotility or perceptual conditions could have been some of the same survey respondents. It was decided not to list subtypes of visual perceptual conditions due to length of survey, so prescribers may be more likely to prescribe BD for one subtype and BU for another.

## DISCUSSION

As with most survey studies, one must be cautious not to over generalize the results. Less than 10% of COVD members participated.

It is possible that these participants are more enthusiastic in the use of vertical yoked prism than non-responders. There may be other underlying differences in mode of practice, patient demographics, clinical training, and other unknown factors.

These data provide some insight into the use of vertical yoked prism among COVD members. Clearly, vertical yoked prisms are not a rare or fringe element in optometric practice. The vast majority of optometrists in this sample of 123 use vertical yoked prisms in vision therapy, in habitual spectacle prescriptions, and for individuals on the autism spectrum.

Most respondents utilize both BD and BU in therapy. The majority who prescribe follow the traditional recommendations of BD for esophoria and myopia and BU for exophoria. A significant minority prescribe the reverse. The one controlled study on binocular and accommodative function by Schmidt et al<sup>20</sup> (n=45) found that BD and BU yoked prism had no effect on divergence, convergence, and most accommodative functions. There was a cross sectional study, so positive or negative effects of habitual wear could not be determined. Case reports may provide longer observation, but case reports cannot control for confounding, placebo, or selection bias. One topic for future research is whether prescribed vertical yoked prisms in either BD or BU over several months wear effects binocular or accommodative function particularly with respect to direction of phoria. The equal use of BD and BU for oculomotility disorder is an interesting finding. It was not investigated whether there were other factors to explain the discrepancy. It may be that the patients with oculomotility disorder and esophoria are prescribed BD and those with exophoria are prescribed BU. In either case, vertical yoked prism for oculomotility disorder represents a topic for future research in larger sample sizes. Another potential topic is vertical yoked prism for myopia control. The author found no longitudinal data published on vertical yoked prism for myopia control.

Regarding posture, vertical yoked prism of a certain magnitude does change posture.<sup>19</sup> The change correlates to vertical displacement of the image in space as expected. Thus, the prescription of vertical yoked prism for visual field defects, toe walking, or occupational tasks is based on traditional optics. However, of the few studies performed, prescription in patients with normal visual fields, gait, and functional vision does not appear to improve subjective function, visual motor tasks, gait, binocular, or accommodative function.<sup>18-21</sup>

A few reports support improved perception and visual behavior in patients on the autism spectrum.<sup>6-7,10,13</sup> However, improvements occurred with either BD or BU. Could the stimulus for improvement be change in fixation or visual perception rather than expansion or compression of visual space? A topic for research would be on change stimulus, and expanding on Kaplan's<sup>6,7</sup> work on magnitude, frequency, and direction of prisms therapeutically. Optometric researchers could also measure binocular, accommodative, and refractive variables to determine if those conditions influence success or rejection of vertical yoked prism or preference of prism direction in persons on the autism spectrum.

In summary, participants in this survey of COVD members use vertical yoked prism frequently for both therapy and prescriptions. A review of the literature reveals case improvements, but direction of base and magnitude of prism varies. This variation was reflected in the results of the present survey. Thus, further research on safety, methods of use, and efficacy appear appropriate to determine standard procedures and limitations of application.

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**AUTHOR BIOGRAPHY:**

**Stanley W. Hatch, OD,  
MPH, FAAO, FCOVD**  
Philadelphia, Pennsylvania

Dr. Hatch currently serves as Chief of the Pediatrics and Binocular Vision service at Salus University, Pennsylvania College of Optometry. He received his Doctor of Optometry from Michigan College of Optometry in 1990 and completed his residency in pediatrics and vision therapy at the Pennsylvania College of Optometry under Dr. Mitchell Scheiman in 1991. He received a Master of Public Health from Harvard Chan School of Public Health in 1995; he is a Diplomate in the American Academy of Optometry and a Fellow of the College of Optometrists in Vision Development. He is married to the lovely Adina K. Hatch. They are blessed with two sons, Benjamin, (23), Joshua, (20) and a dog, Savannah (14).