PERSPECTIVE

A Paradigm Shift in the Treatment of Amblyopia

Robert B. Sanet, OD, FCOVD

Pilar Vergara Giménez, OD, FCOVD

Leonard J. Press, OD, FAAO, FCOVD

In *The Structure of Scientific Revolutions*, Thomas Kuhn notes that new ideas, sometimes built upon ones that have previously been discarded or overlooked, can influence a discipline to change its thinking about a particular subject. This happens neither easily nor overnight. Kuhn writes:

> *"If a paradigm is ever to triumph it must gain some first supporters, men who will develop it to the point where hardheaded arguments can be produced and multiplied."*[1]

Our goal in this perspective piece is to provide a framework of support for a paradigm shift in the approach to treatment of amblyopia. Older paradigms essentially conceived of amblyopia as a monocular phenomenon. The National Eye Institute of the National Institute of Health in the United States (NEI/NIH) characterizes amblyopia as "a medical term used when the vision in one of the eyes is reduced because the eye and the brain are not working together properly."[2]

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Dr. Sherman's Landmark Paper

We trace the impetus for conceptualizing amblyopia as a binocular problem to the pioneering work of Dr. Arnold Sherman. In a landmark paper published as a viewpoint in the Journal of Behavioral Optometry in 1995, Dr. Sherman proposes that *the visual acuity loss in amblyopia is only the monocular symptom of a binocular problem.*[3] He references a talk that he gave at a COVD meeting in 1977 during which he promoted the importance of teaching the patient to process visual information through the amblyopic eye within a binocular field, procedures that subsequently came to be known as MFBF or monocular fixation in a binocular field. Binocular integration as an approach to amblyopia would become one of the guiding principles on the subject in the textbook *Applied Concepts in Vision Therapy,* when originally published in 1997.[4]

In his 1995 paper, Dr. Sherman writes: "If binocular interference is the major etiological factor in amblyopia development, treatment must be designed to eliminate it and achieve binocular cooperation. The binocular difficulty includes suppression as well as other adaptations that patients make to avoid binocular vision, and may include an increase in refractive error in the amblyopic eye to facilitate suppression and eliminate binocular confusion." That is a crucial insight re-conceptualizing anisometropia, particularly low to moderate hyperopic anisometropia, as a maladaptation to binocular imbalance rather than as the underlying cause of amblyopia.

Coupling the observations that compliance with occlusion was poor and went against the grain of binocular integration, together with his concept of anisometropia as an adaptation to be discouraged, led Dr. Sherman to suggest that amblyopia would be best treated without occlusion and with prescribing for significantly less than the full amount of anisometropia.

Sherman's philosophy was again reflected in the chapter on Amblyopia in *Applied Concepts in Vision Therapy* which states: "The first step in any form of amblyopia therapy is to apply a prescriptive lens that improves visual function. Recall that our definition of amblyopia includes not just a reduction in visual acuity, but a decrement in accommodative, oculomotor, and general visual processing ability. Even when there is little or no apparent improvement in visual acuity when the amblyopia is initially assessed, a lens should be prescribed if improvement in any pertinent visual skills can be demonstrated."

Indices for Success in Amblyopia

Given the traditional emphasis on visual acuity reduction as the sine qua non or defining sign of amblyopia, it is not surprising that criteria for success typically revolves around the extent of visual acuity improvement. In his seminal article, Sherman cites an Amblyopia Success Index (ASI) formulated by Meyer et al using the denominator of the Snellen fraction as follows:

ASI = (Initial VA - Final VA) / (Initial VA - Test Distance) x 100

As an example, if the initial acuity was 20/60 and improved to 20/30, the ASI = (60-30/60-20) = (30/40) x 100 = 75%.

In the metric system, initial acuity was 6/18 improving to 6/9, so ASI = (18-9/18-6) = (9/12) x 100 = 75%.

Given the significance of amblyopia as a binocular problem, Sherman proposed an analogous Binocular Success Index (BSI) using Wirt Circle Stereopsis (WS) in seconds of arc as a guide. A maximum value in most commercially available tests of 20 seconds of arc is the constant. His formula is:

BSI = (Initial WS - Final WS) / (Initial WS - Maximum WS) / x 100

As an example, if initial stereo acuity was 100 seconds of arc and improved to 30 seconds of arc, the BSI = (100-30) / (100-20) = (70/80) x 100 = 88%.

He suggested that the more appropriate index of success in amblyopia would be the average of the ASI and BSI, in this instance (75 + 88) / 2 x 100 = 82%.

While the numbers in Sherman's example don't seem significant when differentiating between a 75% level of success and an 82% level of success, combining ASI and BSI obviously becomes more significant when stereopsis improves to a considerably greater extent that visual acuity. For example, using the formula for ASI, a patient who improves from 20/50 to 20/40 would be assigned a success index of only 33%. But if that patient improved from 100 seconds of arc to 20 seconds of arc, BSI is 100% which doubles the overall success index to 67%.

Although we do not formally use Sherman's suggested amblyopia indices in practice, it is fair to say that he almost single-handedly helped move judgment about the success of amblyopia therapy away from the narrow metric of visual acuity and more toward the extent of binocular integration achieved.

Binocular Gateway to Amblyopia Therapy

At the ARVO meeting in 2008, the research group at McGill University of Mansouri, Thompson, and Hess rolled out their binocular approach to amblyopia therapy.[5] In 2010, they authored a case series in Optometry and Vision Science involving three strabismic amblyopes who engaged in dichoptic video training to promote fusion. Acuity through the amblyopic eye improved as suppression reduced and binocular vision strengthened together with the development of stereopsis.[6] In a review paper for Vision Research in 2015, Hess and Thompson addressed the timeline of the binocular approach to amblyopia therapy incorporating electronic games, citing a 1981

article by Press as representative of behavioral optometric approaches.[7]

Speaking at the International Congress of Behavioral Optometry in 2014, Vergara unveiled her successful binocular approach to amblyopia therapy without occlusion built upon the principles originally introduced by Sherman. This mirrored the methodology published by Press and Press in 2012 on reverse engineering of hyperopic anisometropic amblyopia based on Sherman's pioneering work.[8] Several years later, Vergara incorporated her thoughts on lens prescribing and binocular therapy for amblyopia in a book titled Crossed and Lazy Eyes: Myths, Misconceptions and Truths, oriented toward parents and professionals, published by OEP.[9] Most recently, the VisionHelp Group created an online resource for parents to promote understanding of the binocular approach to vision therapy.[10]

Summarizing the Paradigm Shift

Sanet and Vergara have lectured internationally on a behavioral optometric neurofunctional approach to amblyopia treatment, synthesizing Sherman's principles into treatment protocols. Their approach can be briefly summarized as follows:

No standard occlusion at all, even for monocular VT procedures. In some cases, a Bangerter filter can be applied to the spectacle lens of the non-amblyopic eye to re-balance contrast and binocular integration.

The lens prescription is rarely the maximum prescription obtained on refraction. Unlike the classical approach, it is not prescribed primarily to achieve refractive or accommodative balance between the two eyes, but to minimize binocular competition and maximize overall performance. Prescribing the lowest lens power that provides maximum reduction in binocular competition is the most crucial component in producing optimal clinical outcomes.

Few if any monocular procedures are employed in vision therapy. Therapy emphasizes MFBF and binocular procedures from the outset.

The majority of patients under six years of age achieve 20/20 visual acuity and 20 seconds of arc within three months of beginning therapy. Rapid gains are made within the first month.

During the 50th annual COVD meeting to be held in Canada next year, we will be elaborating this model and presenting illustrative cases from practice. We hope that you will be able to join us, and that our perspective will help shift your paradigm away from the monocular conceptualization of amblyopia.

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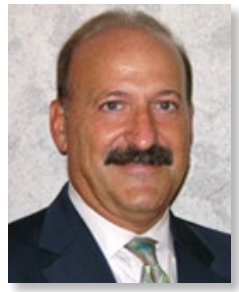

AUTHOR BIOGRAPHY:
Leonard J. Press, OD, FAAO, FCOVD
Lakewood, New Jersey

- OD 1977, Pennsylvania College of Optometry
- Principal Owner, Press Consulting, P.C.
- Adjunct Faculty, Southern College of Optometry
- Editor-in-Chief, *Vision Development & Rehabilitation*
- Past President, COVD