The Prevalence Of Visual Conditions In A Population Of Juvenile Delinquents

Paul Harris, O.D.

Optometric Extension Program

In today's society the problems of school dropouts, delinquent behavior of our youth, and crime on our streets are increasing while our resources for education, incarceration and rehabilitation are shrinking. Few programs have had significantly positive or long-lasting effects on any of these societal problems. The optometric profession has long recognized the important role that vision and the visual process plays in allowing a person to be a productive part of society and culture. Research has shown that many juvenile offenders have significant visual conditions which should be considered major contributive factors to their inability to perform and conform to the demands of society.

The initial work done by the research team for the Optometric Center of Maryland (OCM) reported here reveals a prevalence of visual conditions which, in order to properly serve on a country- wide basis, will challenge the profession of optometry to its core to meet these identified needs with sufficiently trained manpower.

In July1987 the OCM was awarded a one-year grant from the Juvenile Justice Advisory Council, and advisory council to the Governor of Maryland, which administrates the annual distribution of nearly $750,000 to projects and studies related to juvenile services. The current project calls for a full three-year study of the relationships between visual conditions between juvenile delinquency and the role that visual training plays in the rehabilitation of these youth.

Three major hypotheses are being tested by the OCM research project. They are:

1. A very high prevalence rate of visual conditions exists in the population of juvenile delinquents.
2. These visual conditions are treatable through the use of appropriate nearpoint plus and optometric visual training.
3. Treatment of these visual conditions will lead to increased performance in the areas related to reading and educational performance and reduced recidivism.

Since the words "vision" and "visual conditions" can and will be understood differently by those reading this paper, a few definitions are provided to help those with different orientations to comprehend the terminology used.

> VISION: The deriving of meaning and direction of actions through the use of light energy. Vision does not reside in the eyeball nor in any single structure in the human but rather emerges from the coordinated use of the entire organism to derive meaning and direct action.[1]

This definition of vision is very different from the one typically used by the public. Most people, when they think of vision, think only of visual acuity or the clarity with which they see.

The way vision is used in this paper refers to the entire process whereby the person actually derives meaning from that information which enters through his eyes and other senses all the way to the actual accuracy and efficiency with which he directs his actions. The actual output or movement, be it overt or covert, that the person makes is a reflection of his visual processes.

Vision, as defined above, is both learned and developed. Purposeful movements which manipulate the environment are the basis on which this development and learning occur. When a person's motoric output is less than adequate to meet the demand of a particular task, more often than not the difficulty is a visual one, not one of poor muscular development or of some defect in the physical structure of the body.

VISUAL CONDITIONS are any significant deviation from those expected visual abilities or status which a person should have in order to cope with the demands placed upon him. Most visual conditions are either developmentally or stress-related, although any one person may have a mixture of both. A developmental visual problem relates to the lack of an important ability which was either never learned or developed, or was learned or developed in an inappropriate way. An example of such a problem would be the person who has not learned to track with his eyes independent of the rest of his head and/or body. This person moves his head and/or upper body to try to stay with the moving object. This, generally, represents a lack of development and/or learning of how to do this, not a physiological problem with the extraocular muscles.

Stress-related visual difficulties are caused by misuse, overuse or disuse of the visual process. In any living organism, over time, function will alter structure. When a living organism calls upon its physical structure to perform a movement or function over and over again then those structures will, in time, be altered so as to reduce the chronic stress on them.[2]

The current research, as being conducted by the OCM, is investigating all three hypotheses by using the research protocol described herein. Permission was obtained to set our testing and treatment services at the Charles H. Hickey, Jr. School for Boys in Baltimore County, Maryland. This is a juvenile detention facility north of the center of Baltimore City. It houses all of the Maryland juvenile offenders who have either committed the most serious crimes or who have been incarcerated most often. The school population is between 325 to 400 juveniles at any one time with about five to ten percent being in the maximum security area at one time. Until recently, the population was all male. Now up to ten percent of the population is female.

New residents at the facility are brought into the testing portion of the program soon after they arrive. Entrance testing is done by

educational staff of the school and includes the reading subtest of the California Achievement Test. Those scores are provided to us. As available, the youth are then scheduled for our complete vision testing battery. Appendix A includes the complete protocol used in the vision testing, Paul Harris, O.D. who is not directly involved in doing any of the testing or the treatment, is given the records. The records are randomized based on age, number of arrests, reading scores and area of the state to assure that the groups are as homogenous as possible. The design of the study is double-masked. The optometrists doing the testing do not know and have no input about which youths go into which of the three groups. These optometrists are not involved in providing the vision therapy and/or the alternative treatment. The staff that provides the actual vision therapy and the alternate treatment is not involved in any of the testing.

The three groups are the control, the alternate treatment, and the experimental groups. The control youths are simply tested upon entry and upon their leaving the detention facility. The juveniles' time at the facility averages five to six months. They receive no other care from our staff. The alternate treatment group is being given 24 half-hour sessions of individualized reading instruction in the same physical location as that used by the vision therapy group. The experimental group is being given 24 half-hour one-on-one session of vision therapy along with the most appropriate nearpoint plus lenses which are provided to them for use in school.

Complete post-testing is being done on all members of all three groups prior to their being released from the facility. This includes retesting by the educational staff of reading performance levels. From that point, the juveniles will be followed so that recidivism can be measured. Recidivism will be considered as any re-entry into the penal system.

This paper will address only the first of the three hypotheses. Later papers will address the other stated hypotheses. Not enough data has been collected to confirm or deny those hypotheses.

The Data

To date 132 subjects have gone through the complete entrance testing. The ages of the subjects range from 13 to 19 with the average age being 16 years 9 months. Table 1 shows the breakdown by age for the entire population.

Table 1.

Age	Number
13	1
14	12
15	25
16	31
17	29
18	28
19	6
Total	132

First a pre-examination questionnaire is filled out for each student. The questions are asked orally by the examiner so that the reading level of the subject does not affect the accuracy of the subject's report. A copy of this questionnaire is included as Appendix B. On the middle section of the first page, 20 questions which are indicators of possible visual conditions are asked of the subject. These include such questions as: "Do you experience double vision? "; "Do you cover an eye? "; " Do you hold reading material close?"

The average number of items checked as problem areas for all 132 subjects was 7.44 with a range from 0 to 17. Four or more positive answers on this checklist are felt to be reason enough to believe that a significant visual condition exists. Table 2 shows the frequency of symptoms noted and the number of subjects in each category.

Table 2.

Number of Symptoms	Number of Subjects
0	4
1	4
2	9
3	13
4	11
5	8
6	4
7	9
8	16
9	8
10	7
11	16
12	12
13	3
14	3
15	2
16	2
17	1
Total	132

Each subject was asked what the highest grade he completed in school. The lowest grade completed was fifth, with several having competed their senior year in high school. The average grade completed was grade 8.5. The reading subtest of the California Achievement Test was conducted by the educational staff at the Hickey School as part of their entry tests. The score was used to properly place the youths in appropriate level classes. The subjects ranged from a low of grade 1.5 to a high of 12.9, with average reading scores being grade 5.6.

Many of the subjects seen in the study had been arrested several times before coming to the Hickey School. For a youth to come to the Hickey School after only one offense means that that offense must have been a particularly serious one, such as rape or armed robbery. The number of offenses in the research population ranged from one to 11 offenses, with the average number being 3.42 offenses.

The New York State Optometric Association (NYSOA) KD Saccadic Test was administered. This test consists of three paragraphs of numbers which the subject is asked to call off as quickly as possible. On the first paragraph the numbers are widely spaced and have lines between them to help the subject keep from losing his place. The second paragraph has similar spacing but without horizontal lines, and the third has the same amount of numbers with the vertical dimension shrunk down so that the horizontal lines of numbers are closer together. Each row has five numbers. The fastest score was 34.5 seconds for all three paragraphs, with one subject taking as long as 317.8 seconds. The highest norm for the test is 50.46 seconds for age 14 with a standard deviation of 5.84 seconds. Ninety-five (95) subjects were slower than this norm. Fifty-two (52) were slower than 62.14, which represents two standard deviations away from the norm for age 14. Thus, depending upon the criteria used for establishing pass/fail, from 39.4 to 71.9 percent failed this test.

"The Groffman Visual Tracing Test consists of five separate, continuous, consorted, and intersective lines in a tangled pattern on an 8 ½ " x 11" card. Each line begins at a letter at the top of the card and follows a random,

twisting path throughout the card and terminates at a number at the bottom of the card. The student's task is to visually trace each line from its beginning to its end as rapidly as possible. It is primarily an oculomotor task."[3]

Two factors are measured, speed and accuracy. Points are awarded only on those trials which are followed to their corresponding correct endpoints. More points are awarded for faster correct responses. The total number of points possible are 50, 10 for each of the five trials. The average score for all subjects was 22.58. The highest norm for this test is, for age 12, at 32 points. Based on this score, 95 subjects were slower that the 12-year-old norm. The standard deviation for the age 12 norm is +/- 4 points. Seventy (70) subjects were slower that two standard deviations below the normal score for age 12. Depending upon which criteria is used, from 53 to 71.9 percent of the subjects failed this test.

The Wold Sentence Copy Test consists of a single sentence which is to be copied as quickly as possible. The sentence to be copied is printed on the top portion of the page with lines below provided for the subject to copy the sentence. The task is timed and observations as to posture, pencil grip and working distances are made by the examiner. The average time for the subjects tested was 96.3 seconds with a range from 46.0 to 253 seconds. The norm for grade eight is 105 seconds. Thirty-nine (39) or 29.5 percent of his subjects were slower than this.

The observations of the examiner were compiled and analyzed. Only 12 of the subjects did not have one or more of the following difficulties: improper pencil grip, improper posture, improper working distance, or inappropriate subvocalizations.

The Jordan Left-Right Test [4] is composed of three parts. Part I consists of two sections, one of letters and one of numbers, some of which are printed backward. The subject is asked to identify which letters and numbers are indeed backward and to either circle or cross them out. Parts II and III consist of words and sentences within which some letters or words are either printed or spelled backward. The average score on the entire test was 17.84 errors with a range of from a perfect 0 to 88 errors. The ranges and averages on each part were as follows:

Table 3.
Jordan Left-Right Discrimination Test
Subtest Scores

Section	Range		Average
	Low	High	
IA	0	10	.87
IB	0	15	1.52
II	0	34	9.12
III	0	44	6.42
Total	0	88	17.84

According to the manual, the highest norm for boys in this test are for the age group from 12.6 to 12.11. Any score of nine or higher is considered a failure. Ninety-nine (99) of the subjects, or 75 percent, failed this test.

The Motor-Free Vision Perception Test investigates the important areas of visual discrimination, figure-ground discrimination, visual completions and visual memory without using the motor responses of the patient in the measuring criteria. There are 36 samples on the test. The highest norm for the test is for age 9.0 years and is a score of 30 or more. No higher norms exist for this test as it only investigates those developmental abilities

Table 4.
Visual Acuity

	Distance			Near		
	Right	Left	Both	Right	Left	Both
20/20	88	90	102	128	128	129
20/25	19	17	15	1	1	1
20/30	12	11	7	1	1	1
20/40	5	6	1		1	
20/50	1	1	2	1		
20/60	1	1	1			
20/70		1				
20/80				1	1	1
20/100						
20/200	4	3	3			
20/400	2	1	1			
NLP*		1			1	

*NLP = No Light Perception

expected at or below developmental age nine.

The lowest score recorded was only three correct, which is below any of the norms available. Nine (9) subjects scored the maximum possible score of 36 points. The average score was 30.89. Thirty-five (35) students scored below 30 points, which would place them developmentally at or below age 9.0. This represents 26.5 percent of the subjects tested.

At this point, each subject was escorted into the vision examination room and seated in the chair before the staff optometrist who conducted the rest of the testing. Distance and near visual acuities were taken first. Only a few of the boys wore glasses. All acuities reported here are without any form of compensatory lenses. Table 4 shows the unaided visual acuities of the subjects. The horizontal line separates those considered to have passed and failed this test. Above the line is considered passing and below would be failure.

Table 5.
Cover Testing

	Distance	Near
Exotropia		2
High Exophoria	1	2
Med Exophoria		11
Low Exophoria	1	43
Orthophoria	128	70
Low Esophoria	1	3
Mod Esophoria		
High Esophoria		
Esotropia	1	

In most visual screenings of visual acuity the cutoff for failure and referral would be a visual acuity worse than 20/40. By this criteria only eight right eyes and eight left eyes representing only different subjects would have been referred. Of those, three had lenses which allowed them to see better

than the referral cutoff point. At near there were only two right and two left eyes on two subjects which did not meet the 20/40 criteria. While using both eyes together only one person was not able to see at least 20/30 without the aid of any compensatory lenses at near. Thus, visual acuity difficulties are not evident in significant numbers in this population. This is not surprising as most visual conditions that affect visual acuity are of the nearpoint stress-induced type, which this population has generally avoided. It is, typically, the goal-oriented achievers who continue performing sustained nearpoint activities in spite of the stress encountered, and over time this function alters the structure and they develop the various visual maladaptations which decrease visual acuity.

Cover testing was done at both distance and near. The cover-uncover was done first, followed by the alternate cover test. Table 5 summarizes the cover test results.

At distance only one person had a strabismus. This was an esotropia of low degree. At near one subject went into a constant exotropia and one intermittently was in an exotropic posture. The subject who was estropic at distance remained so at near. The significantly broader spread of the group at near, with many moving toward exophoria, is consistent with the fact that most of this group, when confronted with nearpoint visual stresses, choose "flight" rather than "fight". By this, it is meant that they choose to "throw in the towel" or stop trying, rather than to preserve in the face of the stress.

Motilities or tracking abilities were tested next. The subject was asked to follow a highly reflective target, Wolff wand, which was moved in front of him in varying speeds and directions. The alterations of speed and direction increase in degree of difficulty along developmental lines until the person is no longer able to stay on the target. See Appendix A for the complete instructional set. Subjective evaluations were made by the examiner in reference to the amount of supportive head movement made and as to the accuracy with which these movements were done. Only two of the subjects demonstrated a large amount of supporting head movement while 22 showed a moderate amount. This left 108 subjects whose tracking was done with a steady head and upper body.

The accuracy of the eye movements was rated on a scale of poor, fair, good, excellent. None of the subjects showed poor eye movements. Nine subjects displayed fair eye movements, 79 were rated as good, with 44 being rated excellent.

Convergence nearpoint was tested using the same Wolff wand. The wand was placed at eye level directly in front of the subject at a distance of about 18 inches. The wand was slowly moved closer to the subject and the distance at which either the subject reported seeing double or when the examiner could see any misalignment of the eyes or breakdown in binocularity was recorded as the break point. The wand was then slowly pulled away from the patient toward the examiner until either the patient reported seeing one ball again or the examiner noted the eyes to be back into alignment. This point was recorded as the recovery point.

Reach grasp release testing was done as follows: The subject was asked to look at the examiner's nose and then asked to jump his eyes to the target and then back to the examiner's nose. The target was moved closer and closer to the subject's nose along the midline of the subject at eye level. At the point that the target was brought in too

close, so that the subject could no longer jump with both eyes converging on the target, the reach point was recorded. Observations were recorded as to the efficiency and accuracy of all movements. However, only the reach point is reported here. Table 6 summarizes the findings.

A subject is considered to have failed either of these two areas if either the break point on the convergence nearpoint test is farther out than two inches from the subject's nose or if the reach point on the reach grasp release test is farther away than two inches from the subject's nose. Fifty (50) subjects, or 37.8 percent failed the convergence nearpoint testing while 48 or 36.4 percent failed the reach grasp release testing.

Color testing was done using Ishihara plates. Four of the 132 subjects showed some color abnormality. Wirt stereo testing was done at near. Table 7 shows the distribution of scores:

Table 6.

	Convergence Break	Nearpoint Recovery	Reach Grasp Release
To nose	9	9	12
1"	50	43	51
2"	23	11	21
3"	21	9	28
4"	13	17	14
5"	6	12	3
6"	6	6	2
7"	1	8	
8"	1	5	1
9"		1	
10'		3	
11"		1	
12"	1		
14"			
18"	1		
25"		1	

The low degree of stereo demonstrated by this population was not expected. For a period of time the test itself or the Polaroid glasses were suspect. However, when checked by the examiner both were normal. Replacement sets of Polaroids and of the Wirt stereo did not change the results on this test. Many tests of stereo acuity measure to an even finer threshold of 20 seconds of arc. Using the measure of 60 seconds of arc, or grosser, as failure, 48 or 36.4 percent of the subjects would fail stereo acuity. It should be noted that this measures the ability to make fine depth judgments within arm's reach similar to the judgments needed to properly thread a needle or to work on an assembly line, working with small parts which need to be placed accurately in specific positions and orientations.

Table 7.
Wirt Stereo Acuity

Minutes of Arc	Number
40	73
50	12
60	5
80	5
100	9
140	8
200	9
400	3
600	1
800	4

The Analytical Examination

Next, a standardized analytical sequence was run on the subjects. Since the analytical is considered to be a single unit from which inferences about various aspects of behaviors and vision are made, rather than seen as disjointed individual probes of certain physiological measures, the report here will not include statistics on each finding but rather what the analytical yields in the area on insights into the subject's

vision and behavior. The analytical yields the following information:

1. Past adaptations that the person has made are revealed.
2. Current levels of adaptation are observed and revealed along with their readiness and ability to deal with new stressors.
3. The person's "direction of movement" of his space world. From this one may infer a preferred problem solving mode and the way that person deals with perceived stress.
4. The level of embeddedness.

Additional Definitions

Some additional definitions of terms need to be introduced at this point to provide insight into how the above information is gleaned from the analytical.

The Space World is the internal representation of reality (some may argue that that is the reality) that each person constructs within his mind. This representation is, by its nature, very complete. This assesses the schemes available to the organism to utilize that knowledge. Lack of coordination or correspondence between the measurable physical world and the representational world exists for each person. These areas of discoordination are the basis for inaccuracies or inefficiencies in performance. The diagnostic evaluation performed by a behavioral optometrist probes not only the direction and degree of the discoordinations between these two worlds, but also probes the current direction of adaptation and the level to which these discoordinations have been compensated in changes in the actual structure of the patient. Chronic postural and movement asymmetries are the results of intrinsic disequilibrium or discoordination which lead to warps or distortions of the space world. Another way of assessing the space world is by taking an inventory of which schemes the patient uses for which tasks. Systematic warps of the space world or directional movements of the space world, under certain conditions of demand are evident in the behavioral optometric diagnostic procedures.

The person acts on the environment, using his space world as a base of understanding and organization. The person will direct action toward the spatial location of the object in the space world which may or may not correspond to the actual position of the object in reality. The person incorporates elements of all the senses to construct a space world. Each individual may be aware of his space world and more or less aware of certain senses.

Changes in the structure of the organism of maladaptations include, but are not limited to, myopia, adverse hyperopia, astigmatism, amblyopia, strabismus. They are attempts by the person to resolve inadequacies of equilibration between his space world and reality. (An adaptation becomes a maladaptation when, in the course of making the change, the potential of the organism to meet future unforeseen demands has been limited in some way.)

There are several directions of movement of the space world that are normally identified. These include inwardizing (toward self, centripetal). Outwardizing (away from self, centrifugal) and directional changes in the volume of space being utilized (compression verses expansion). Inwardizing movements of the space world occur when areas of the space world shifted nearer the person than

the corresponding object is in reality. Outwardizing movements occur when areas of the space world are shifted away from the person, relative to the corresponding position of the actual object in the concrete world. Compression and expansion relate to the amount of space or the portion of the space world that is being utilized at any point in time by the person from which the individual is currently basing his decisions. The person who has compressed space deals with relatively smaller portions of the space world at any moment in time. By expanding the attended space volume, more of the space world is used by the individual. It is recognized that both inwardizing and outwardizing directions of movement are present in the same individual in relatively different amounts, in different directions of action, and under different conditions of attention and performance. As part of the diagnostic testing, we measure relative tendencies toward one direction of movement over the other.

Embeddedness is a measure of the level to which a discoordination between the space world and reality has been or is being adapted in changes in the structure of the organism. When an adaptation is said to be less embedded, it is less so in structure and more evident in a space world discoordination, A more highly embedded adaptation is one that is more a part of the structure of the organism. At the highly embedded endpoint, inwardizing and outwardizing tendencies may have reached a more balanced state. If this is so, the adaptation tends to reveal itself in changes in the volume of space, compression or expansion.

The #7 finding (distance subjective) yields information relative to what changes the person has undergone in the past in direct relation to the visual stressors with which that person has dealt with. This gives us a direct measure of either how much function has altered structure or is in the process of altering structure. Table 8 shows the breakdown of the spherical and cylindrical components of the #7 findings on the 132 subjects.

The average dioptric power for the right eye sphere component was +0.57 and +0.64 for the left eye. The average cylindrical component for all subjects was –0.27 for both the right and left eyes. In 111 subjects, or 84 percent, right spherical components were within the range of from –0.25 to +1.25. One hundred and thirteen (113), or 85.6 percent of the subjects, had left eye spherical components within the same range. Only six subjects, or 4.5 percent, had cylindrical components in either the right or left eyes greater than –1.00 diopter. Ninety-one (91) subjects, 68.9 percent, had no measurable cylinder in the right eye while 89, or 67.4 percent, were free of cylinder in the left.

In general, the population tested has had little dealing with sustained near visual stressor. The distributions of refractive conditions are similar to those expected in a population that has had little if any contact with sustained near vision demands.

The findings taken as averages would indicate that this population has not made significant alterations of their visual process. Further, the lack of change indicates a lack of both volume and intensity of working with sustained near visual demands.

When confronted with the stress of near-centered demands, the individual, as well as all living organisms, may elect to continue dealing with the stressor (fight) or to remove oneself from the action of the stressor

Table 8.
#7 Finding

Dioptric	Sphere		Cylinder	
Power	Right	Left	Right	Left
-5.75	1			
-4.00			1	1
-3.75	1			
-3.50				1
-3.00	1	1	1	
-2.50				1
-2.00			1	
-1.75		1	1	
-1.50			1	1
-1.25	1		1	2
-1.00		2	8	5
-0.75	1	2	13	8
-0.50	5	2	14	18
-0.25	8	6		6
Plano	13	15		
+0.25	8	12		
+0.50	18	24		
+0.75	27	17		
+1.00	25	20		
+1.25	12	19		
+1.50	6	3		
+1.75	2	2		
+2.00	3	3		
+2.25		2		
+5.00		1		
+5.50	1			

(flight). Although these appear to be two very polar choices, this is not really the case. There is actually a continuum between extreme fight and total flight. The difference is obvious immediately when one considers the differences in how one might read the sports page about a team he doesn't follow versus how a technical article is read when it is being read for a test or how a contract is read just prior to its being signed. The differing levels of intensity are not from the reading material but are from the within the individual and are in proportion to the person's needs and perception of the strength of those stressors.

The higher the level or intensity of stress induced, the stronger the conflict and the more polar (fight or flight) will be the response. For example: Less conflict is response. For example: Less Conflict is caused by reading the newspaper or the funny papers and, therefore, the people reading this material would be broken up into rather narrow distribution from flight to fight. Very little force to change is generated

in those continuing to read and very few people throw in the towel and give up. The forces are generally weak, and a narrow differentiation is made. Conversely, the conflict is strong when technical material is read for a test. The forces for strong fight or flight are present. Those who continue will do so with higher levels of general and local measurable stress than when reading the lower demand material. Those who avoid will do so earlier and they do it more totally. In our society, which is very goal oriented and more positively regards those that continue dealing with stressors (fighters), total avoiders are looked down upon. Avoiders may develop a style of deriving meaning from near-centered tasks which artificially reduces the intensity of the conflict. They develop reduced visual efficiency.

Reduced visual efficiency is a way of deriving meaning while reducing the intensity of the presented conflict by remaining somewhat aloof from the demand, yet continuing to attempt to derive meaning. From all outward appearances the person looks as though he is doing some work but appears to be lazy. He gets a general impression of the material read. If tests are made on the global aspects of the material rather than on specific pieces of information, this individual may actually do well. Reduced visual efficiency is the most popular adaptation to chronic stress in our species. It preserves the integrity of the organism.

In order to preserve their integrity, the majority of our subjects have developed this reduced visual efficiency. Thus, the refractive findings are very much like that expected in the normal 6-to-8-year-old age group, not that of a 13-to-19-year-old group in which much more diversity or spread would exist in the refractive findings. One would expect a significantly higher rate of myopia in more subjects, along with more adverse hyperopia, and greater numbers of subjects with astigmatism.

Directions of Movement

Insights into the directions of the subjects' alteration of their internal space world are gleaned from the relationship between the two distance and two near prism break points. If the relationship between the break points at distance leans significantly more toward the base-inside, then it is postulated that the subject's space world would be distorted outward or centrifugally for those objects that are beyond arm's reach. If the near base-out break is significantly higher in ratio to the near base-in break point, then the direction of distortion of the space world would be inward, toward self or centripetal. Table 9 summarizes the ratios and the distribution at distance and near for the subjects tested.

Table 9.
Direction of Movement of the Space World

	Inward	Neutral	Outward
Distance	27	13	86
Near	47	57	21

The ratio of base-out break points to the base-in break points at distance ranged from a low of 0.00 to a high of 8.00. On the low end the subject in question had a base-out break at 0 prism diopters and a base-in break point of 38 diopters. At the other extreme that subject had a base-out break of 40 prism diopters and a base-in break of 5 prism diopters. At distance the subject was classified as having outward movement if the ratio was from 0.00 to 1.50, neutral from 1.51 to 1.80, and inward if the ratio was over 1.81.

The range of the ratio computed at near, comparing the base-out break points with

the base-in break points, was from a low of .22 to a high of 3.00. On the low end the subject had a base-in break of 36 and a base-out break of 8. On the high end the subject had a base-in break of 36 and a base-out break point of 12 prism diopters. At near a subject was classified as having an outward movement if the ratio was from 0 to 0.89, neutral from 0.90 to 1.10, and inward if the ratio was over 1.11.

Different practitioners, each with his own unique vision and observational ability, learn to read the level of embeddedness in different ways. The Optometric Extension Program Foundation, Inc., in its "black" book, puts forth a fairly complex method to derive the level of embeddedness. The author and members of the Baltimore Institute for Behavioral Optometry (BIBO) have derived their own method for calculating the level of embeddedness from the analytical which is simple in concept and application. To fully understand this method, it is important to understand how the findings are taken. The equilibrium findings or ductions (#9, #10, #11, and #16, #17) are taken using open rather than pointed questions. The target used is a projected chart at distance with the letters from 20/60 to 20/20 being displayed and a block of 20/20 letters at near. For complete directions please refer to Appendix A.

The Following is a sample open question used to elicit patient responses just prior to the taking of the equilibrium findings: "I am going to make some changes occur. I want you to tell me every change that you notice just as it happens, sort of like a radio announcer." The subject is not directed toward any specific response or event that might occur. An example of a pointed question might be the following: 'Tell me when the letters blur or double." Typically, the subject might notice many other changes but will only report the blur/or break point if noticed. The open question sets the stage to find out what happens what changes the subject notices. Since all the changes are available for everyone to see, those reported would be the ones which that person felt were moist relevant. Those changes available to be seen that are not reported are felt to be less important or possibly below the subject's sensitivity of change or just noticeable difference (JND). In this scheme, the fact that a subject might not report seeing blur or double is just as important as his reporting seeing those events.

Insight is gained into the level of embeddedness by looking at the ratios of the break points to the recoveries in each of the equilibrium findings. NOTE: This may only be possible to do accurately or with a high level of confidence if the findings are taken as described in Appendix A and above. The following rules apply:

1. The lower the recovery in relation to its associated break point the less embedded the case.
2. The higher the recovery in relation to its associated break point the more highly embedded the case.
3. The combined ratios on the distance equilibrium findings yield a level of embededdedness at distance.
4. The combined ratios on the near equilibrium findings yield of embeddedness at near.
5. The total, combined ratios for all equilibrium findings, yield a measure of embeddedness of the person.
6. Differences in the distance and near ratios may indicate significant differences in the degree to which function has altered structure at those relative distances in space.

Table 10.
Equilibrium Findings

Finding	Average Break	Average Recovery	Average Embeddedness
Distance Base-Out	27.93	5.30	0.19
Distance Base-In	22.88	3.25	0.17
Near Base-Out	30.65	5.84	0.20
Near Base-In	28.59	6.49	0.23

In general, the subjects tested were relatively insensitive to the differences available to be seen on the equilibrium findings. Few reported seeing blurring of the target in any of the four sets of findings. The break points reported were relatively high and the recovery points relatively low. Table 10 shows the average responses for these findings, and the computed embeddedness factor for each.

The average embededdedness is computed by dividing the recovery by the associated break point. The number can range from 0 to 1. Table 11 shows the classification system used.

Table 11.
Classification of Embededdedness

Ratio	Classificiation	Number of Subjects
0-0.25	Highly Nonembedded	90
0.26-0.50	Nonembedded	18
0.51-0.75	Embedded	3
0.76-1.00	Highly Embedded	0

All of the average embededdedness scores above fit into the highly nonembedded classification. When looking at individual scores, they range from a low of 0.015 to a high of 0.675. Table 11 also shows the number of subjects in each classification. Only those subjects who had complete findings on all of the equilibrium findings are included above.

Table 12 shows a breakdown into 13 areas which have been reported earlier in this paper, with counts of how many subjects failed in each area with cumulative statistics for all areas combined.

Table 13 shows the total number of graded areas failed by the subjects. Thirteen areas in all were graded as pass/fail. The criteria for determining the pass/fail status for each subject was leniently determined in favor of pass for each area. Even with the criteria set as such, only two subjects passed all areas and only four subjects failed one area. The average number failed areas was just over five failures.

Discussion

The population of juvenile delinquents tested at the Charles H. Hickey, Jr. School in Baltimore County, Maryland demonstrates that visual conditions are prevalent in slightly over 98 percent of the population! Hypothesis number one has been fully supported by the testing of this group. If this population can be used to make inferences about juvenile delinquents in general, then the implications for training manpower and for well-designed programs for prevention, early detection and treatment must be forthcoming and must become part of the efforts of our society to deal with this very serious problem.

Table 12.
Testing Summary

Test Area	Criteria For Failure	Number of Failures	Percentage
Symptoms Checklist	4 or more symptoms checked off	102	77.3
NYSOA King-Deiv	Slower than 62.14 seconds	52	39.4
Groffman Visual Tracing	24 or less points	70	53.0
Wold Sentence Copy	Slower than 105 seconds	40	30.3
Jordan Left-Right	9 or more errors	99	75.0
Motor-Free Vision Perception Test	29 or fewer points	35	26.5
Visual Acuity	Either eye less than 20/40 at distance or near	8	6.0
Cover Test	Any strabismus or phoria greater than 15 diopters	4	3.0
Motilities	Head movement greater than "S" mall or Accuracy Less than "E" xcellent	92	69.7
Convergence Nearpoint	Farther out than 2"	50	37.8
Reach Grasp Release	Farther out than 2"	48	36.4
Refractive Status	Myopia –026 Hyperopia +1.26 Astigmatism	30	22.7

The analytical data shows an extremely high nonembedded population in which the subjects have made few adaptations in their refractive status. Most subjects are not equipped with the basic necessary developmental visual abilities to handle the demands that are placed upon them in the educational environment. Upon encountering nearpoint stressors with their undeveloped visual systems they have chosen to "throw in the towel" rather than continue to fight against the stressors present. Most have entered a state of change as determined by the degree of the nonembeddedness. They have not yet made many changes in the actual structure of the body or visual apparatus.

Analysis of the direction of movement data show that at near there is a tendency toward inwardizing which is indicative of the first stage of the stress response to sustained near closer than identification. However, this has not yet spread to distance. This information would lead us to believe that this population of juveniles indeed gave up very early, possibly as early as first grade.

Hypothesis two and three as set forth in the beginning of this paper are presently being tested via the mechanism of a longitudinal, double masked, highly controlled research protocol. Future papers will address the ability if the profession of optometry through the use of appropriate nearpoint plus lenses and the administration of optometric vision therapy to treat the visual problems. The impact of this optometric intervention will also be monitored on changes in reading ability, level of education attained, recidivism and job earnings after release. It is expected that all areas will improve as a direct response to the treatment rendered and

not due to other factors such as the Hawthorne of placebo effects.

Table 13.
Overall Summary

Number of Areas Failed	Frequency	Percentage
0	2	1.5
1	4	3.0
2	13	9.8
3	19	14.4
4	17	12.8
5	21	15.9
6	17	12.8
7	19	14.4
8	9	6.8
9	8	6.1
10	3	2.3

This paper establishes the fact that serious visual conditions exist in juvenile delinquents both in number of subjects (greater than 98 percent) and in numbers of visual problems (on average five out of 13 graded areas have problems). The profession of optometry has a major role in both the diagnosis and treatment of these problems.

Acknowledgments

The Optometric Extension Program Foundation, Inc. for its financial support of the continuing research phase of the project.

The Juvenile Justice Advisory Council to the Governor of the state of Maryland for its wisdom in awarding the initial grant which started the program.

Mast Development/Keystone View Division for its generous donation of vision testing and training equipment.

Bernell Corporation for providing needed equipment at reduced costs.

Teletherapy for donating Jeff Cooper's computerized vision training device for testing and treatment.

Special thanks for their outstanding contributions to:

Ann Flournoy, Administrative Assistant,

and Michele Petrecca, Chief Vision Therapist

The following people, listed in alphabetical order, have contributed significantly to the success of the program.

Jill Asch, Student Intern
Diane Gordy, Liaison to Governor's Office
Amy Fox, Student Intern
Judy Hainley, Editor
Howard Hartzell, O.D.
Elizabeth Hodgson, Optometric Technician
Kathy Peterson, Student Intern
Bernard Saltysiak, O.D., Consultant
Barbara Scheetz, Student Intern
Vincent Simoncinni, O.D.

Bibliography

1. Harris, PA. Perspectives on behavioral optometry, a model of vision. J. Optom Vis Develop, Vol 17, No. 4 (Dec 1986): 1-6.
2. Harmon, DB. Notes on a dynamic theory of vision, third revision. Published by the author, Austin Texas, Feb 1958
3. Groffman, S. Visual racing, manual of instructions for classroom use. Keystone View, 1967: 2.
4. Jordan, BT. Jordan left-right reversal test manual. San Rafael, CA: Academic Therapy Publications, Revised editions 1974.

APPENDIX A

Examination Protocol for Juvenile Delinquency Study
Done by the Optometric Center of Maryland
Written by Paul Harris, O.D., F.C.O.V.D.

The following is the testing sequence used for the Juvenile Delinquency Project as done under the direction of Paul Harris, O.D., F.C.O.V.D., the primary investigator under the auspices of the Optometric Center for Maryland. The following is a set of specific guidelines. However, it is understood that each optometrist retains the right to be an individual-thinking diagnostician and is not bound in total by the guidelines laid down. Since each patient who presents for vision care is a unique individual, and since each diagnostician uses his own unique visual abilities to observe those patients, there may be some portion of his visual evaluation and needs that must be dealt with in a totally unique manner.

The Behavioral Examination

NOTE: In the following text specific reference will be made to the examination form used at the Optometric Center of Maryland.

The case history will not only identify the same chief complaints as the problem-oriented optometrist but will survey in a standard and general, yet specific to that patient, manner areas in which vision is affecting that person's performance. The main reason for conducting a history is to establish the visual needs of the patient.

Pre-examination Questionnaire

7-8 Min.
This form will be filled out by one of the staff members of the study in consultation with the juvenile. The questions will be asked of the juvenile verbally and the answers will then be recorded by the JD staff person. See Appendix B ("JUVENILE DELINQUENCY"). This questionnaire will take the place of a formal case history that would normally be taken by the optometrist in an "open" question format.

King-Devic Saccadic Test

3-4 Min.
The King-Devic Saccadic Test, consisting of three tests, will be administered by the JD staff person. The subject will be seated at a work table. The first demonstration form will be placed directly in front of him, straight up and down, and he will be given the following instructional set. "I want you to call off the numbers as fast as you can. This first one is practice. Go ahead". Once the demonstration card is completed it is removed and TEST I is placed before the subject in the same manner. The instructional set given now is, "I am going to be timing you, so I want you to go as fast as you can. Ready? Go". The time for completion is recorded on the recording sheet. Any omissions, additions or sequencing problems are also recorded on the recording sheet. If the subject uses his finger to help keep his place, this is disallowed and he is asked to continue without the use of the finger. If this occurs, it is to be recorded, as well as any unusual postural warps and/or movements.

Once TEST I is completed it is removed and replaced by TEST II. The instructional set is now, "I want you to do the same thing. Ready? Go". When this is completed the

same is repeated for TEST III. All observations are recorded and the recording sheet is inserted into the patient's file.

Groffman Visual Tracing Test

4-5 Min.

The subject continues to be seated at a work space. The demonstration card is placed over FORM A directly in front of the subject. He is told, "I want you to follow the line from letter 'A' and tell me where it ends". When he completes this he is directed to, "Now follow the line from 'D' and tell me where it ends. At this point the following instructional set is given. "The lines you are now going to have to follow are much more difficult. I am going to be timing you. However, you only score points if you follow the line to the correct endpoint. If you go fast and end up at the wrong place, you will not score any points. You will score more points if you get to the correct place in a shorter amount of time. It is important for you to think of this as an accuracy test not a race". The demonstration card is now removed and the subject is told to, "Start from letter 'A'. Go". The examiner points to the letter as it is spoken. A stopwatch is used to time the subject and the endpoint letter found by the subject is recorded, along with the amount of time it took to get to that place. If any significant amount of time is taken between the end of one sample and the next, a hand should be placed over the test so that the subject may not get a "head start" on the next sample. All five lines are traced in order from 'A' to 'E' with the times and endpoints found being recorded. Any observations about the manner in which the subject did the test which are relevant (see the recording sheet) should also be noted.

Wold Sentence Copy Test

3-5 Min.

This test is again placed before the subject vertically with a No. 2 pencil placed in the center of the paper with the tip pointing directly toward the subject. The paper is presented on the subject's midline with no tilt. The subject is simply told, "I want you to copy the sentence onto the lines below as quickly as possible". Frequently, the subject might ask, "Should I print or write?" To this the reply is, "I want you to copy the sentence onto the lines below as quickly as possible. Do it whichever way you can go faster." No other instructions are given. They are timed and at the same time the tester makes and records observations concerning the subject's posture, pencil grip, use of the paper, head tilt, overt the body movements, subvocalizations, etc. The total time is then recorded on the bottom of the sheet and the test paper is included in the subject's record.

Motor-free Visual Perception Test

3-4 Min.

The testing booklet is placed directly before the patient and opened to the first example. The directions given are formally presented on pages 25-27 of the manual that accompanies the test. The subject's response is recorded on the supplied score sheet. Any observations out of the ordinary, such as abnormal posture, subvocalizations, hand or body movements, or observations as to alternate strategies used by the subject are to be recorded. All 36 samples are to be given to all subjects.

Jordan Left-right Reversal Test

4-5 Min.

Form I is placed before the subject. The following directions are given for this page: "You get to be the teacher for once. I had this sheet printed up and someone made some mistakes. By mistakes I mean that some of the numbers and some of the letters are printed backward. I want you to find all of the backward letters and numbers and cross them out". Once this is completed,

Part II is given with the following directions: “I want you to look at all the words on this page one at a time. Some of the words have a single letter printed backward. Some are easy to find because they look funny. Others are harder because nothing looks backward. The key is that every group of letters must make a real word. Some can only be made into real words by reversing a single letter”. Once completed, Part III is given with the following directions: “I want you to read each of these sentences. Some of them have a word that is spelled backward. I want you to find all those with a word that is spelled backward and circle the word that needs to be fixed. Some may have no problem at all; just leave those alone”.

Cheiroscope Tracing/Van Orden Stars

3-4 Min.

The patient is now brought to the standing cheiroscope. It should be adjusted so that he can comfortably stand at the cheiroscope without having to stand on tiptoes or without having to hunch over. For more complete instructions on doing the cheiroscope and Van Orden Stars, please refer to the writings of Streff and Wolff from the S.A. NOEL Center. A brief outline follows:

Cheiriscope:

Insert with target in front of right eye

A. Direct tracing right on right
B. Indirect tracing left hand

Insert new form with the target in front of left eye

C. Direct tracing left on left
D. Indirect tracing right hand

Van Orden Star:

Insert target

Place right hand on upper target

Place left hand on lower target

Instructions: “Look at the center of the page. Keep your eyes on the center of the page and bring the two pencils together right to where you are looking. Be sure to keep looking at the center of the page. Stop as soon as they look like they have touched”.

Place right hand on the second symbol from the top

Place the left hand on the second symbol from the bottom

Have the patient continue on his own and note how much help he seems to need.

The patient is now moved to the examination area for the testing to be done by the optometrist.

Chair Testing

7-8 Min.

Visual Acuity

Visual acuity at distance is measured at first wearing the habitual prescription if it is normally worn for distance. If no habitual prescription is available or is used by the patient routinely, then distance visual acuity is to be measured unaided at first. Acuity is to be taken OD, OS, then OU. The paddle is presented to the patient on the midline and the patient is asked to cover his left eye. Observation is made as to which eye is actually covered and whether or not assistance from either the optometrist or others in the room is needed in determining which eye to cover. Any distortions in posture noted during the history taking and acuities should be recorded on the form just

above the visual acuity testing area following the word “posture” on the form.

If an habitual prescription was used for distance testing, it should be removed to allow for unaided visual acuity to be taken. After recording your data, an appropriate nearpoint reading card is to presented to the patient on the midline at approximately his Harmon distance, without comment about where to hold the target. NOTE: The habitual prescription should be worn for near testing if the patient normally wears the lenses for all sustained near visual tasks. If he uses either a different prescription at near, testing should be done that way. He is then asked if he can read the smallest line on the card. Observation is made about the working distance to which he brings the card and the posture and facial expressions used to read the chart. These should be recorded prior to the interposing of the paddle to get OD and OS visual acuities. Once the working distance has been recorded in the space following the abbreviation “WD” above the visual acuity should be taken and recorded at the Harmon distance of the individual.

Finally, if the patient has not brought the reading target closer, a simple test is done to gain insight into any tendency on the part of the patient to unconsciously bring near the reading material closer. This is done by gently placing your hands on his hands as he holds the reading card and looks at it. Gently push the card closer to the patient’s face. The easier the card is allowed by him to move to the face, the greater is the tendency to do this under the stress of sustained near visual activity. If he resists and does not allow you to push closer to the face, then it is postulated that he does maintain an adequate working distance.

Cover Tests

The Cover-Uncover and Alternate Cover tests are always done. Testing first begins at distance with a single 20/40 or threshold size letter for the individual if the individual is not capable of 20/40 visual acuity wearing his habitual prescription. The Cover-Uncover test is to be done first and is done to answer the question, “Is there a strabismus present?” Contrary to how this test seems to be run, the “Cover” aspect of the test is the most critical, not the “Uncover” part. Observation, although most desirable done on both eyes simultaneously, should be of that is not being covered as the cover is placed on the other eye and observation of movement versus no movement, direction and amount is recorded.

If no strabismus is present, the alternate cover is to identify the phoric indication of the internal spatial computing of the individual. Observations as to direction and amount, along with the recovery ability of the individual, as the cover is removed after last shift is to be noted. Even if a strabismus was present under the Cover-Uncover test, Alternate Cover is still done to ascertain if a different spatial computing of the individual manifests itself under this condition of observation. Once distance testing is completed, the same is done at near. Near testing is done at the Harmon distance in primary gaze using a highly reflective object, preferably a Wolff wand.

Motilities

Testing of motilities is to be done in a full room illumination using a Wolff wand or similar highly reflecting small object. Although no set pattern of testing the movement directions is required, one should be aware of the developmental nature in which scanning of the environment and

spatial organization is learned and developed and apply this knowledge in testing motilities to assess to what level the patient has achieved. The following is a rough idea of the developmental hierarchy involved:

Sequence 1. Horizontal, vertical, diagonal, rotations.
Sequence 2. All head movement with upper body support, all head movement without upper body support, less head movement, no head movement with all scanning being done in all directions with the eyes only.
Sequence 3. Inaccurate or unrelated eye position to target position, mildly related, very related but loses fixation, excellent one-to-one relation of eyes to target. (This is also evident not just by observing the movements of the eyes, but also, when this is achieved there is usually a papillary constriction not evident in any of the above levels of scanning.)

Testing begins at the base level and attempts to identify to what level the patient had developed along all three of the sequences above. Check-off places on the form are supplied to help your probe and recording in this area. NOTE: He is simply asked to follow the ball. The stage is set to see how he would normally do it. You may want to investigate afterward by asking him to hold his head previously. However, this is not the preset normally used. The following is an explanation of the abbreviations:

HD = Head Movement
S = Small
M = Moderate
L = Large
A = All

BODY = Body movement of support
S = Small
M = Moderate
L = Large

ACCURACY = Accuracy
Ex = Excellent
G = Good
F = Fair
P = Poor

LIMITS = Used to record any limitations in gaze

The blank line following ACCURACY would be used to record any other pertinent observations derived from the motility testing.

Saccadics

In the testing of saccadics, two highly reflective targets are to be used. The patient is directed on verbal cue to shift attention form one target to another. The verbal cues are to be at random times and the targets are to be placed at random locations in space. The relative amounts of head versus eye movement and the accuracy of the saccadics are to be noted.

Convergence Nearpoint

The Wolff wand is to be held on the midline close to the observer, with the observer being no more than 24 inches from the patient, and then brought in toward the patient at a rate that would have the target to the patient's nose in about 3 to 4 seconds. He is asked to watch the ball and tell the observer if he notices it change in anyway. This open question sets the stage for the subject to report or not report diplopia. The distance observed, when he no longer is looking at the wand with both eyes together is recorded. At that point, the ball is a little more slowly brought outward to the observer, and the distance that the subject regains normal binocular alignment is also

recorded as the recovery distance. The eye that turns away (either in or out) from the target should be noted, along with the direction of the turn. Whether or not the patient noted seeing diplopia or not is also very important to record. A typical notation would be: 3"/6" OD out NO DIP which means that the patient lost binocular alignment at 3 inches from his nose with the right eye turning outward. The target was then brought out to 6 inches, at which time binocular alignment on the target was regained. The patient did not report seeing two targets.

Reach Grasp Release

For this test the observer's nose and the Wolff wand are used as the two targets. The observer positions himself on the midline of the patient from 20 to 24 inches from the subject's eyes. Starting with the target placed about 2 inches closer to the observer than the break point noted on the CNP testing done above, the observer directs the patient's visual attention to the observer's nose. On verbal command, at randomly spaced intervals, he says, "Look at the ball," or "Look at my nose." The closest distance that the Wolff wand can be brought in toward the patient's nose with the patient successfully turning both eyes inward together is recorded. Qualitative observations are also recorded for anything that is out of the ordinary. This might be an observation that there is consistently a lag of one eye over the other in making the jumps from distance to near or a different leading eye moving inward versus outward, a pulling back of the head, a nonresponsive pupil, etc.

Worth Four Dot

The Worth Four Dot testing at distance is done in as nearly darkness as possible with a large wall-type Worth Four Dot. The direction is, "Tell me what you see." The number of dots reported is recorded. If the situation is changing, ask for all the different ways he can see it without shutting an eye. The observer might also ask for a relative time estimate of how long it remains in each situation. Should the situation be variable, it is important to note whether or not the patient has control over what he sees, or reports what "it" is doing, and whatever changes are occurring.

After investigating the situation at distance, the hand held Worth Four Dot flashlight is then used in a similar fashion. If the CNP showed a receding nearpoint of 4 inches or more, the observer begins moving the Worth Four Dot in and out to see if there is a place where it shifts from 4 to 5 dots in a similar fashion as done on the CNP testing. If it stays at 4, the observer holds the flashlight at the Harmon distance for the individual and uses the +2.00/-2.00 flippers alternately in front of the patient's eyes binocularly and notes any changes in the number of dots reported.

Color

A simple probe using the first several plates of the Ishihara or Dvorine plates should be done. Should a problem be found, then the testing should continue in order to identify the type of color vision loss.

Randot Stereo Acuity

Whenever possible, random dot stereo testing should be done in preference to the stereo fly. This should be done at the appropriate testing distance with whatever habitual near prescription is used by the patient. Record the finest stereo acuity achieved by the patient.

Near Vision Retinoscopy

It is understood that there are many valid forms of near vision retinoscopy that are currently in use in optometry. At the present

time stesspoint retinoscopy is the one of choice preferred by the Clinical Directors of the Optometric Center of Maryland. Refer to Kraskin's OEP Curriculum II chapters entitled "Lens Power in Action" (Series 1, 1981-82, Oct. pp. 25-27) for the complete "How-To" on stresspoint retinoscopy.

END OF THE CHAIR TEST SEQUENCE

Eye Health

1-2 Min.

General eye health, both internal and external evaluations, is an important area of evaluation of all patients. The form lists those areas which are part of the required eye health evaluation. Note: Occasionally, there is a very obvious eye pathology present which would require most of the above testing to be skipped and the examination type shifted to a problem-oriented examination. In that instance, the pathology and any of its ramifications should be thoroughly investigated and appropriate action should be taken without the complete behavioral evaluation being done. On the other hand, one must not lose focus of what is unique to optometry and, as soon as the pathology has either been treated or is under control, a return visit should be scheduled for the completion of the behavioral part of the tesing.

Pupillary testing should be done with a penlight or transilluminator. PERRLA appears on the form and either the "Y" (if PERRLA is true) or the "N" (if PERRLA is not true) can be circled. The same is done for the results of the Marcus-Gunn testing. Any other abnormalities with pupils should be written on the space provided.

Analytical Testing

8-10 Min.

The examination form shows the basic analytical tests that should be run, if possible, on all patients and the order in which they should be run. The corresponding OEP number is at the left of each of the spaces for recording your findings along with an English version of what the test is.

Retinoscopy (#4)

Retinoscopy is a dynamic retinoscopy at distance. The target is a row of 20/40 letters if the individual shows standard visual acuity on the earlier visual acuity testing. Larger letters would be used if the patient was not capable of 20/20 at either distance or near on the previous visual acuity testing. FOGGING is not used in the dynamic retinoscopy. Thus, any working lens before the eye that is not being scoped should be removed. The patient is asked to look at the letters. Additionally, he may be asked to read them to better keep his attention.

Subjective Refraction (#7/#7a)

The following is the method utilized by Paul Harris and is only one method available to obtain an endpoint of refraction known as the #7 finding. A full chart is used from 20/60 to 20/20 size letters and is shown in half red and half green monocularly. The patient is asked which side is clearer, red or green. Large changes are made at first and smaller ones later to, at this stage, help Dr. Harris arrive at the appropriate spherical power to allow for the cylindrical testing coming next. The sphere power left in the phoropter for cylinder testing is the least plus or most minus red response for each eye. Should the patient not be responsive to the Red/Green test, then gross sphere lens changes coming from the plus side would be used. For the rest of the refractive testing, a single line of 20/40 letters is used unless larger letters are needed due to amblyopia or pathology.

If no cylinder was seen on the #4 finding, then –0.25 D cylinder is put in at either 90 or 180, whichever is the most convenient and power is first tested at those axes. If the cylinder is rejected at both axes, then Dr. Harris proceeds to the other eye. If the cylinder tested was-0.25 or –0.50, he starts with testing the power at the axis scoped. If the cylinder is not rejected, he will increase the power to –1.00 and begin axis testing followed by further power testing once the axis has been located. If the cylinder was scoped at –0.75 or greater, he automatically increases the cylinder in the phoropter by -0.25 and begins axis testing first, then power testing once the appropriate axis achieved. If no cylinder was scoped in either eye and unaided acuities were standard, frequently crossed cylinder testing is skipped. NOTE: The least amount of cylinder that the patient requires is what is left in the phoropter. EXAMPLE: If, on the power testing for –0.75, the response is "less cylinder" and at –0.50 is "more cylinder," then –0.50 is left in, not –0.75. If –0.25 response is "more," -0.50 is "confused or no answer" and –0.75 is "less," then –0.25 is left in, not –0.50.

Binocular balance is now done. Some form of dissociating prism is used. On the Greens phoropter the Stevens phorometer is preferable as it has the largest field of view and least chromatic aberrations. On the AO phoropter use 6 diopter vertical prism, and 6 or more if needed to obtain diplopia. If diplopia cannot be achieved, use an alternate cover test. After the cylindrical testing and the balance is achieved, +1.00 D spheres are added binocularly to the powers left in the phoropter by altering the "fog" before each eye to achieve equal "fog" or "blur". Once done, the disassociating prism is removed and the "fog" decreased, or the minus increased, until the 20/40 line is seen well. Then the target is changed to 20/20 and the plus decreased, or the minus increased, until the line first becomes clear and readable without a lot of hesitation or guessing. Record this as your #7 finding. If the line is read slowly or not with ease, continue to reduce the plus, or increase in the minus, and see of there is a significant increase in the speed or in the patient's perception of how the letters look. If they should look larger with more minus or less plus, this should also be noted. When there are significant changes, record this as the number #7 A. If there are no significant improvements when less plus or more minus is introduced over the #7, #7A is to be recorded.

Distance Phorias

The #7 finding should now be reset into the phoropter for the measurement of the induced phoria. Here a single column of letters from 20/60 to 20/20 is used as the target. The directions are, "Tell me when the two lines first become aligned one directly above the other." The patient is not directed to look at one or the other specifically, nor is he told to keep it clear. His attention is directed to the target. Should there seem to be hesitation or slippage reported, the finding may be repeated with both findings being recorded in the order they were taken not as an average.

The Control Lens

If the #7 finding is +1.00 D spheres or less, or –0.75 or less, and binocular unaided visual acuity is 20/30 or better, the phoropter should be cleared and Plano circled as the control lens. This would include the clearing of any cylindrical component if the unaided binocular acuity was 20/30 or better. A note about the control indicator is in order. Many recording systems leave later examiners in the dark about precisely what lens was in the phoropter when certain tests were run. This form, if properly used, should help to

eliminate this practice as much as possible. Whichever base lens was left in the phoropter for the distance equilibrium testing should be circled. If your choice was not found, enter the control on the line supplied. A control must be indicated. The phoria should then be retaken and recorded above on the top line of the analytical in the space noted as the habitual phoria or #3.

Distance Equilibrium Testing

A block of from 20/60 to 20/20 letters is used for the testing. Base-out testing is done first and recorded on the line marked "9/10" followed by the base-in testing recorded on the "11" line. The instructions are as follows, with some variations, of course: "I am going to make some changes in the way the letters look. I would like you to give me a running account of everything that you notice about how they seem to be changing." This is an open-question format. The first sentence sets the stage which lets the patient know that something is going to change. The second asks him to report everything he sees. The observer begins the testing after a simple, "Are you ready?" Everything the patient says and even those things he omits are significant. The blur, break and recovery findings should be recorded in the standard way. The form includes a SILO label following the space for recording the blur, breaks and recoveries. Simply circle the appropriate letters which correspond to the responses of the patient. Any other responses should be written in the margin to the right of the "SILO." Upon finishing the base-out testing, the prisms should be returned to zero before recording the findings and continuing to the base-in. If both the base-out and the base-in can be tested successively, and then recorded, that sequence is preferred.

Near Phoria

A block of 20/20 letters should be used for the testing of the near phoria. Again disassociating prisms should be used and the testing done and recorded as above. This should be done under full illumination. Should the patient not be capable of standard near acuity, an appropriate level chart should be furnished. In the case of a presbyope, this test may be skipped.

Fused Cross Cylinders (#14B)

The crossed cylinders are placed initially with the minus axis at 90 degrees and the crossed cylinder target is placed before the patient at 16 inches. Illumination is reduced. The patient is asked which set of lines appear to be the blacker or clearer. Plus is then added binocularly in large amounts at first with later additions and/or subtractions being of smaller and finer gradations until the response with the side of the most plus or least minus has been identified. As in the cylinder testing where the finding was biased in the direction of the least cylinder, the fused crossed cylinder is biased toward the greatest plus or least minus. Occasionally, a patient is not very sensitive to this test with the cylinder axis at axis 90. In this case try changing both axes to 180 and continue testing. Regardless of the response at the first presentation, +1.00 D spheres are always thrown in over the control lens and a new response from the patient is requested. No findings of minus adds are recorded. Should what has been termed "minus projection" be found, simply record "no add" and continue using the distance control for your near control.

Record the #14B finding in the space provided. You may choose to record the gross lens in the phoropter. If you do, circle the "G" following the finding. If you record the add relative to the control lens, then circle the "A" following your finding. This

reduces ambiguity. For any response other than "no add," a phoria should be taken following exactly the same procedure as above for the near induced phoria except use the #14B as the lenses in the phoropter.

Near Equilibrium

In general, these should always be conducted through #14B lenses. An arrow should be drawn from the #14B finding to the number "16" on the left hand side of the form to indicate that the near equilibrium findings were taken through the #14B lens. If the distance control were to be used, an arrow should be drawn from the control indicator line to the #16 on the right side of the form.

Near equilibrium testing should proceed with the same instructions and recording as with the distance equilibrium findings. The target used should be the block of 20/20 letters, not a vertical line of letters. Again record the responses of the patient by circling all those that apply on the "SILO" indicator and writing any other responses in the margin. Testing of base-out is done first, followed by base-in.

PRA/NRA

This is the only place in the analytical where the testing is out of order with the OEP numbers. The plus to blur-out on the 20/20 block of letters is done first and then the binocular minus to blur-out. Again the observer may record the gross lens power in the phoropter. If so, circle the "G" following the finding. If the number is recorded as an add from the "CONTROL," circle the "A." DO NOT UNDER ANY CIRCUMSTANCES RECORD THE PRA/NRA IN REFERENCE TO THE #14B.

Vertical Testing

Vertical testing is only done if indicated by cover test or patient's subjective comments in the earlier part of the analytical about perceived vertical misalignments. This is not routinely required.

This completes the protocol for both the prediagnostic and postdiagnostic testing series. At the post-testing, the only thing to be excluded is the history questionnaire. All other testing will be done the same time.