2-1-1981

The golden project: Visual profiles of children

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The golden project: Visual profiles of children

Abstract
This paper proposes a method of organizing diagnostic information regarding a patient’s visual system in a graphic profile based on a normed test battery. As a method of manifesting to parents the areas of vision needing therapy, the profile can also be used in-office to monitor the patient's progress and show the efficacy of vision training. Included are examples from a sample patient population, evaluation of the test battery, and suggested adaptations for use by private practitioners.

Degree Type
Thesis

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THE GOLDEN PROJECT:
VISUAL PROFILES OF CHILDREN

Submitted to
the Faculty of
Pacific University College of Optometry
as partial fulfillment of the requirements for the
Optometry Doctorate Degree

by
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February 1981
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ACKNOWLEDGEMENT

Our thanks to Jesse Miller, Jr., Betty Golden, B.J. Seymour, Gary Kappel, Larry Burr, Phil Orange, Dean Kyle, and Rocky Kaplan who laid a firm foundation for the accomplishment of this project. Special thanks to Robert Yolton for his role in maintaining communication throughout the project's development.

DEDICATION

In memory of the late Robert Golden, an advocate for developmental optometry.
ABSTRACT

This paper proposes a method of organizing diagnostic information regarding a patient’s visual system in a graphic profile based on a normed test battery. As a method of manifesting to parents the areas of vision needing therapy, the profile can also be used in-office to monitor the patient's progress and show the efficacy of vision training. Included are examples from a sample patient population, evaluation of the test battery, and suggested adaptations for use by private practitioners.
Does vision therapy work for you? Sometimes? How do you know whether or not your diagnosis is correct? Is the treatment working in the area of vision that will truly help your patient? What visual meterstick do you use to evaluate the efficacy of visual therapy? Can functional aspects of vision be measured with the same scale as the structural aspects? Perhaps it is time for a new measuring tool.

RESEARCH LIMITATIONS USING VARIOUS STANDARDS

Many people have studied perception,\(^8,12,28,32,37\) motor development,\(^9,11,16,18,24,34,35\) and vision training as it affects reading,\(^4,5,13,29,43\) learning disability,\(^25,28,36,40\) and scholastic achievement;\(^25,36\) typically the results are mixed. If no clearcut relationships have been documented,\(^21\) it is not to say that none exist.

There are design limitations in clinical research that in part account for the mixed results in the literature. First, data gathered on a heterogeneous group of subjects tends to mask specific relationships that may exist (this masking effect is one main criticism of the perceptuo-motor reading studies that have been done). Also, people are quite adaptive to problems that frequently confront them, so a second problem of clinical studies is compensation. When a child adapts to a weakness in one area of the visual system, he/she may compensate using an entirely different mechanism. Thus even real improvements in that weak area of visual function may affect task performance very little, hiding the success of the visual training.
Third, a major confounding factor in comparing therapy results between different clinicians is the lack of control of training techniques and interpersonal exchange. It is known that the doctor-patient relationship plays some role in the person's progress in vision therapy—just how much of a role is still hotly debated.23

Fourth is the question of maturation effects during the therapy period which combined with other intervening variables could conceivably cause changes as great as those happening to these children due to the training itself.

Finally, there is an ethical consideration in clinical research. Ideally, the control subjects should be a diagnosis-matched group of children in need of training with whom placebo training or no therapy at all is done. But consider that these subjects are real people with the need for the best therapy that can be provided. Also remember that a child's use and misuse of his/her eyes creates a neural action that sets a precedent.10 Growth proceeds according to the organism's reaction to learning variables; thus the longer he/she waits, the more habits remain to be unlearned.

These five factors interplay in various combinations throughout the literature, clouding the issue of the efficacy of vision therapy. In order to deal with the first three confounding variables (heterogeneous masking, compensation, and standardization), the Golden Project members, a group of clinicians, professors, social workers, and optometric interns, using an interdisciplinary approach, took a first step
toward a new evaluation tool by compiling a specific, standard set of
tests used in the measurement of visual functioning. The test battery
that evolved will be termed the "visual profile".

THE PROFILE CONCEPT

Few researchers have attempted to describe their patients in
terms of a profile, although many have investigated the effects of
training. Two studies have used the term "profile": Wick's paper on
American Indians,42 and Mohindra's on deaf children.26 Factors con­sidered in the former were refractive error, phoria, and eye health;
and in the latter, refractive status, perceptual motor integration,
binocularity, pathology, and color vision. Mohindra found definite
perceptual and spatial maturation lags in deaf children as well as
lower myopia. The native American children showed more hyperopia,
astigmatism, exophoria, and pathology. The main emphasis of both works
was to compare an unusual population to existing norms. In this pur­pose, these previous profiles are similar to the Golden Profile.

However, the expansion of the profile concept into a 42 test
sequence also serves to eliminate heterogeneous masking by showing more
aspects of the patient's functioning. The separate evaluation of sub­sections of visual behavior also serves to show improvements in indi­vidual categories that might otherwise be hidden by adaptive compensa­tions. Finally, the choice of tests that are standardized for the most
part and generally known to educators begins to facilitate communication
with parents, teachers and within the optometric profession.

COMPOSITION AND OBJECTIVES OF THE PROFILE

This profile is a compilation of information about the patient's status with respect to social-environmental, visual, perceptual, and perceptuomotor functioning. Its sources are parent, educator, social worker, and optometrist. The profile is designed to juxtapose patient performance in major areas of behavior graphically so that an overall picture of the child and his/her problems may be gained. The major objective in constructing such a profile is to observe graphical patterns of optometric, perceptual, and psychological findings which may eventually be used to develop diagnostic keys to therapy prescriptions.

PROFILE CONSTRUCTION

In accordance with this purpose, certain principles were agreed upon by all contributors in the mutual effort to construct this profile. First, standardized and widely accepted tests were used whenever possible. Second, all participants in the project had to consent to the areas selected and the specific tests chosen to test those areas. This principle was the cause of numerous lengthy discussions and compromises.

It was agreed that a social-psychological inventory should
be taken on each child. In the area of learning disability it has been established that personality tests can be helpful in the diagnosis of remedial needs. Learning disabled children apparently are less able to recognize and label emotions, that is to empathize. Reasons given are auditory and visual misperceptions, inability to selectively attend, and lack of experience.

Also, studies considering the reliability of response times indicates that time lags found in every intersensory and intrasensory condition may be a better index in the determination of the learning disabled than error scores. The differing "conceptual tempos" of reflective versus impulsive personalities has led to the characterization of the learning disabled as having short delays but incorrect responses and the better performers as having longer delays but correct responses. Environmental influences may also play a role in conceptual tempos and learning styles.

A study using the Raven Coloured Progressive Matrices divided children into lower and middle class groups and found overall longer response times and better performance with the middle class group; these same performers had the ability to adjust the speed of response so that correct responses were made quickly and uncertain responses more slowly. In the lower class group, latencies were shorter and response times did not vary for correct versus incorrect responses.

Just as social-psychological influences play a role in
academic and visual success, the reverse may also occur. Olson's studies on college students discovered trends toward increases in reading comprehension and academic achievement and toward better patterns of adjustment on personality inventory scores after the completion of vision training. However, groups receiving counseling only (and no vision training) also experienced the same positive personality trends. The authors describe this as possibly due to "test wiseness" in which subjects gained knowledge, with experience, of how to answer test questions to their own best advantage.

Although there were significant gains in reading rate for vision training subjects, the Olson study found no statistically reliable changes on mental ability test scores as a result of vision training. Another study by Wold and Pierce confirms that gains in word recognition and in academic functioning are found after vision therapy.

In order to evaluate the child's social/psychological condition, an interview with the social worker, parent, and teacher questionnaires were requested.

The parent and teacher questionnaires gathered facts and determined attitudes of the family and child. Parent questionnaires asked about the child's visual problems and symptoms, academic and social difficulties and strengths, number of schools attended, interests and abilities, home environment, and a survey of the medical history including pre-natal data, general physical health status and
assessments of visual, dental, auditory and speech development.

Teacher questionnaires examined the child's academic achievement, and the social, visual, auditory, speech, motor, reading and writing, and concept development aspects of behavior. Both teacher and parent forms included the O.E.P. checklist of behaviors associated with visual problems.

After separate interviews with parent and child, the social worker combined these findings with the information from the questionnaires, rating the child on a scale from 1 to 10 to develop a social-environmental profile. The six areas evaluated were:

1. Physical functioning
2. Emotional functioning
3. Social functioning
4. Educational functioning
5. Environmental functioning
6. Family functioning

The next area the profile chose to cover is a rather diverse collection of tests that was labelled "Perception". If vision means more than just visual acuity, then perceptual abilities are important considerations. Perception has been defined as the total reaction of an organism to multiple stimulation; it is the ability to recognize the existence of messages in the surrounding world, to decipher them, and in doing so to be more aware of the self as a receiver and supplier of information. In the process of growth, then, an individual's
reactions depend on the opportunity for exposure to a great many learning variables. 10

It is generally agreed that a battery of tests, rather than the use of a single test in each area as the sole diagnostic, is of utmost importance. 15.20

Because perceptual disability or motor disability cannot be assumed on the basis of poor visual motor integration ability, it is important to test these functions separately. 18

Basically, the perceptual tests in the Golden Profile test three general areas: (1) visual processing free of motor interaction, (2) visual process integrated with motor performance, and (3) fundamentals.

Area 1:

a) Motor Free Visual Perception Test (MVPT)
b) Jordan Left-Right Reversal Test
c) Raven Coloured Progressive Matrices (RCPM)

Area 2:

a) Developmental Test of Visual-Motor Integration (VMI)
b) Maryland Visual Scan

Area 3:

a) Pierce Saccade
b) Stereo Reindeer

The MVPT looks at six categories of perception: (1) Orientation in visual discrimination, (2) Figure-Ground, (3) Shape and figure-

The validity of using the MVPT is derived from its ability to measure an independent variable, perception, relatively free of correlation with intelligence and free of interaction with motor skills, making it appropriate for testing on mentally retarded children, as well as on the motorically handicapped. The MVPT has been used as one of the tests in a Vision Perception Battery to determine underachievement.

A child who scores poorly on the MVPT may indicate in his schoolwork and in his behavior that he (1) mistakes words with either the same or similar beginnings (figure-ground), (2) fails to recognize the same word in a following sentence (visual memory), (3) confuses likenesses and minor differences (form perception), (4) confuses the same word in the same sentence (visualization), (5) fails to visualize what is being read either silently or orally (spatial relationships). The scoring for this test uses standard deviations from the normal error score for the child's age.

The Jordan Left-Right Reversal Test tests the ability to perceive the orientation of number and letter patterns in space. It requires the child to identify letters, numbers, and for higher ages,

*Dr. Rocky Kaplan, Vision Therapy Diagnostic Manual, Portland Optometric Clinic of Pacific University, Portland, Oregon 97201.
words that have been transposed. The Jordan is appropriate to test
directionality in a wide range of ages, with different testing instruc-
tions dictated, depending on the age group. Scoring is on a percentile
basis using age and sex established norms.

The correlation between the Jordan and the diagnosis of
learning disabled children is supported by a study in which these
children scored outside the norms. It has been found that these
left-right concepts can be improved with training.

The Raven Coloured Progressive Matrices is a test of abstract
reasoning ability. It requires the child to select from a number of
choices of partial designs to complete a given overall pattern. Designed
to be used on children, the Raven is often utilized to determine cog-
nitive manipulative abilities. Scoring is on a percentage basis.

The Beery Developmental Test of Visual-Motor Integration has
been widely used to test a subject's ability to combine visual form
discrimination with motor co-ordination. Basically the test
sets forth a progressively more difficult sequence of geometric forms
to be copied. The sequence of forms used covers an age range between
approximately 2 to 15 years.

Both gross motor and fine eye-hand co-ordination are necessary
to progress successfully on the VMI. The grading is based on the
expected ability for a given age level and is scored in years above or
below the chronological age. When deficiencies in a patient's gross
motor behavior as defined on the VMI are found, they may be associated
with clumsiness, overactivity and inability to complete a task on time. *

The Maryland Visual Scan is the only perceptual test in the profile with a time factor; a subject is given 60 seconds to link as many zeros as possible on a test sheet with 66 zeros mixed in with 371 other symbols. An evaluation is made of the number and pattern of linkages resulting in a scan age (determination of scanning maturity). This test has been used as part of a screening battery for functional vision problems.  

The high correlation between the deficit of perceptual motor skills and learning problems makes it imperative that a children's eye examination include both mechanical and perceptual-motor tests so that children having visual difficulty can be identified.  

Once individual differences in perceptual abilities are assessed and compared to age equivalents, corresponding techniques for remediation can be developed.

Determination of the quality of the nearpoint stereoscopic response is made with the Stereo Reindeer; stereo percentages that correlate with the number of seconds of arc perceived are recorded on each patient.

*Dr. Rocky Kaplan, Vision Therapy Diagnostic Manual, Portland Optometric Clinic of Pacific University, Portland, Oregon 97201.
Although some research has found that stereovision is absent in the 6 year old (accompanied by poor binocularity, especially at nearpoint), other research has indicated that it is in the three to four year old category in which many children fail to respond.

Some authors feel that the two and three year old almost certainly does have stereoscopic depth perception but that comprehension factors inherent in the nature of the test do not allow this perception to be measured. Failures to respond may also be due to instructional set and motivational and attentional deficiencies. Cooper, et al found that stereoacuity test scores improve with the subject's age, that performance variability decreases with age, and that normal adult findings are achieved by 7 years of age.

The Pierce Saccade Test is used binocularly at the appropriate working distance to measure the saccadic ability of individuals from six years to adulthood. The test shows a patient's ability to look from numbers on the left side of a page to numbers on the right side of the page without losing his/her place or moving the head. The numbers are closer together as the test progresses, and the time required is noted. An evaluation of total time for the three subtests, with separate scoring for additions, omissions and errors and for head movements, is used to determine a normed age performance score.
This perceptual area of the graphical display was the most difficult to represent because of the variance in the units. The perceptual tests were scored on a unitary scale arbitrarily designating equality between percentages, standard deviation, age equivalents and point scores with a ceiling of ± 3 standard deviation units.

THE OPTOMETRIC TESTING

The Golden Profile's assessment of an individual's visual function is made using the expecteds of the OEP 21 point analytical exam. Findings were graphed in reference to the OEP expecteds, using the standard deviations developed by Haynes.*

Nearpoint (preliminary) entrance skills include push-ups and pursuit movements (motilities) using a bead target, and vergence facility testing using an 8 Base-In and 8 Base-Out prism rock. Accommodative rock is done using a plus-minus 2.00 D flipper. Entrance testing of ocular motilities was graded according to the 4 point system of Wold and Pierce (1978) with 3 being considered the norm.43

SAMPLE PROFILE

When constructed, a blank profile (shown in Figure 1) shows the scaling and juxtaposition of the various tests. The center hori-

*Dr. Harold Haynes, Pacific University College of Optometry, Forest Grove, Oregon 97116.
zontal line is the norm or expected reference. Those scores above the line are higher and those below the line are lower scores. The key is that the profile contains a large amount of information in a small amount of space, making it a good tool for clinical research as well as a mode of communication both outside and inside the profession.
PART II

APPLICATIONS

Having established the profile concept and the Golden Profile as an entity, the question is how to use them clinically.

The most obvious use to be made of an individual's profile is to use the graph as a visual aid during consultation with the patient's family to determine the advisability of entering therapy. Then, at the end of a specified time unit, the patient may be re-examined using the same test battery to show the effects that training has manifested. It may be used to reveal patterns of behavior in subsections of performance, guiding the practitioner to choose certain therapy exercises based on the areas that remain in need of more work.

At the termination of vision therapy, for example, in Figure 2 the graphical depiction of these findings delineates areas of weaknesses and strengths and shows changes that have taken place after 18 weeks of vision therapy.

A second use is the standardization of treatment by the observation of similarities in subsections. For example, in two training patients, placing all findings on the same graph (Figure 3) reveals similarity in the configuration of their personality sections and in unit value of 13 other findings in the performance sections.

If underlying patterns are found when findings of two or more patients are compared, these may be used to specify diagnostic categories and therefore to determine therapy procedures that might
be effective for any patients that fall in that category.

A third use of the profile concept in clinical research is to evaluate the efficacy of vision therapy. The Golden Profile was applied on a small scale to demonstrate its value as a research approach.

Subject selection was from the patient load in several Oregon towns where the clinicians practice, as well as from the patient population of the Portland Optometric Clinic of Pacific University. Patients were screened for pathology and willingness to participate in the project. They were sorted into "normal" and "abnormal" categories on the basis of three criteria: (1) academic complaints, (2) analytical findings, and (3) asthenopic complaints. If the parent and teacher questionnaires indicated a problem area in schoolwork, or if 21 point findings were clustered outside the OEP expected, or if symptomology such as headaches was present, the subject was placed in the abnormal category.

The abnormal group was made up of 8 subjects, 4 boys and 4 girls, from ages 7 to 16; the normal control group was composed of 4 boys and 7 girls from ages 7 to 14.

After parent and teacher questionnaires were completed, the child participated in the perceptual testing and in the interview with the social worker who recorded, described and scored the patient's socio-environmental functioning. Separate interviews were held with the subject's parent(s). Then all of the pre-training data was sent to Pacific University where it was compiled into the patient's profile.
The normal children completed their obligations to the project. Five of the abnormals continued to see an optometrist participating in the project until they no longer needed training, or 18 office visits, whichever came first. At that time, a post-training test battery was done, identical to the pre-training battery, parent and teacher questionnaires again completed, and another social interview done. These profiles were then graphed and compared with the pre-training data. An identical regimen was followed on three of the abnormal subjects by the interns in the Portland Clinic. Although the interns rotated through training, the advisor provided continuity in his supervisory capacity.

Results of this study show some interesting trends supporting the hypothesis that vision therapy changes behavior. To verify this hypothesis, it would be expected that test scores would be high or average for the normal group, similar for the post-therapy abnormals, but lower for the pre-therapy abnormals. 20 of 42 averaged findings showed this relationship.

In Figure 4, a composite (averaged) profile shows normals and abnormals before and after training. Line coding permits comparison of all three groups on the same graph.

Attesting to the real differences between the normal and abnormal samples, only 8 out of 42 averaged scores showed normals below the abnormals. The 17A, 17B, 17R, 11B, 13B, 14A, 14B and 21N are all lower on normals than on abnormals before training. In all other per-
formance tests, normals score the same or higher than do abnormals before training.

Looking at a tally of individual scores, a bar graph (Figure 5) compares performance and personality findings in normals and in abnormals before and after vision therapy. Percentage figures are used to demonstrate differences between abnormals before and after therapy.

The increase in average and high groups of findings in both performance and personality areas show the positive changes that occur after therapy for the abnormal group. Major decreases are seen in low category findings as patients shift into higher levels of performance during the 18 weeks. There are a significant number of abnormals functioning at overall higher levels of performance after therapy.

All of these data show a trend to support the hypothesis that vision therapy changes behavior.

Figure 6 uses Venn diagrams to compare sets of tests. Set I illustrates test scores in abnormals that changed > one unit from pre- to post-training, this change was in the positive direction in all tests shown except for the personality category of "Educational Functioning" and the 14B finding. Both of these showed a decrease of one unit. It may be that a decrease in Binocular Cross Cylinder findings is not detrimental to performance if excesses in either direction hamper visual functioning.

Similarities (within ½ unit) among test scores when normals and abnormals after training are compared are shown in Set II. The
intersection of Sets I and II show tests on which abnormals before training scored lower than the control normal group but increased after training to become similar to normal group scores. These tests are the best indicators of progress for a training patient.

Both Sets III and IV show similarities; Set III shows similarities among tests on which normals and abnormals before training scored within $\frac{1}{4}$ unit of each other. Set IV shows similarities among tests on which abnormals before and after training scored within $\frac{1}{4}$ unit of each other.

The intersection of Sets III and IV shows test scores on which abnormals before training scored close to normals; these scores remained unchanged after vision training. These tests were the poorest predictors of progress during vision therapy.
TIPS FOR USE IN PRIVATE PRACTICE

In considering the profile concept for use in private practice, the researchers would advise making a few modifications. Regarding the social/psychological inventory, those who have no access to a professional social worker could combine case history and observations with teacher and parent questionnaires designed to evaluate key personality factors in the success or failure of vision therapy. For example, motivation, frustration, parent relations, physical co-ordination, dependency, nutritional awareness, social interaction, and scholastic functioning could be rated on a scale from 1 to 10, with 5 being the norm.

Second, to make scaling and juxtaposition easier, it might be best to score the perceptual area of testing based on performance age. That is, the "norm" line would show equality between the chronological and performance age; a score one unit below would show a child performing one year below the average for his/her age.

This performance age scoring would also make it easier for various doctors to modify the graphical display by adding in their favorite age-norm referenced supplemental testing.
SUMMARY

The profile is a graphical depiction of a patient's findings and a portrayal of his progress during vision therapy. It can be used to develop therapies specific to diagnostic categories and it can illustrate categories of weaknesses and strengths. When used as a demonstration for parent and teacher, pre-training levels can be graphed to demonstrate present performance levels and delineate areas of weaknesses that need to be trained. After a specified unit of vision training, findings can be superimposed on the same graph to show which areas have improved and determine which areas, if any, still need work. In this way, progress in vision therapy can be periodically assessed and demonstrated—a step toward the larger goal of answering the question, "Does vision therapy work for you?"
I.
II.
III.
IV.
V.

1. Push-Ups
2. Pursuits
3. Motilities
4. A.C.
5. Rock
6. Prism Rock

Stereoreindeer
Pierce
Saccade

Physical
Emotional
Social
Educational
Environmental
Family

M.V.P.T.
Jordan
Maryland

#8
138
9
11R
16A
168
16BR
17A
17BR
17
10R
9
11
10

Stereoreindeer
Pierce
Saccade

Figure 1
I. Push-Ups
II. Pursuits
III. Motilities
IV. A.C. Rock
V. Prism Rock

Figure 2

Stereoreindeer
Pierce Saccade

Time
Errors
Movement
Jordan
Maryland
M.V.P.T.
Beery
Raven

Physical
Emotional
Social
Educational
Environmental
Family
Figure 3
Pattern Similarity Abnormals Before V.T.

I. Push-Ups
II. Pursuits
III. Motilities
IV. A.C. Rock
V. Prism Rock

# 8
13B
9
10
10R
11
11R
16A
16B
16BR
17A
17B
17BR

# 4
7
7A
5
14A
14B
#21N
19N
20N

Stereoreindeer
Pierce
Saccade

Time
Errors
Movement
Jordan
Maryland
M.V.P.T.
Beery
Raven

Physical
Emotional
Social
Educational
Environmental
Family
Comparison of performance and personality trends by normals and abnormals before and after V.T. Percent change is difference between abnormals before and after V.T. High and low scores are greater than one unit above and below the norm, respectively.
Figure 6
TEST VARIATIONS

Set I - Differences: Tests on which changes greater than or equal to one unit were made between Abnormals Before vs. After.

Set II - Similarities: Tests on which Normals and Abnormals After V.T. scored within one-quarter unit of each other.

Set III - Similarities: Tests on which Normals and Abnormals Before V.T scored within one-quarter unit of each other.

Set IV - Similarities: Tests on which Abnormals Before and After V.T. scored within one-quarter of each other.

I ∩ II - Test scores on which Abnormals were different than the Normals Before V.T. but similar to the Normals After V.T.

III ∩ IV - Test scores on which Abnormals scored within one-quarter unit of Normals originally and remained unchanged After V.T.
REFERENCES


